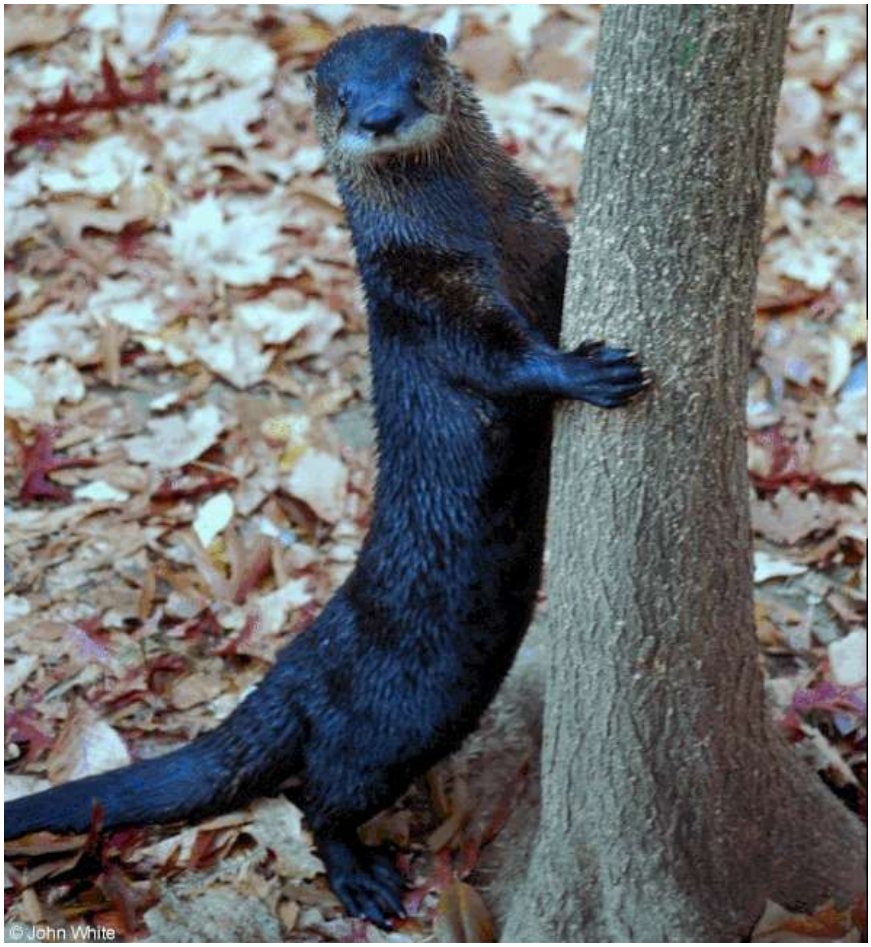
Chapter 2



John White

River otter

Affected Environment

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Introduction

This chapter describes the physical, biological, cultural, and socioeconomic environment of Montezuma NWR and the surrounding area. We provide descriptions and historical perspective of the physical landscape of the refuge and region. We also describe current refuge administration, refuge programs, and specific refuge resources.

Physical Environment

Major Historical Influences Shaping Landscape Vegetation

To evaluate future management options, it is useful to understand the historical types of natural vegetation on the refuge. For Montezuma NWR, several factors have influenced the distribution and composition of vegetation, including glaciation, ecological processes, and human disturbance. Because habitats change over time and it is difficult to determine specific historic habitat types, we describe a historical range of variation in habitats. This approach recognizes that vegetative communities are not static and shift over time. Preserving biological diversity can therefore best be attained by maintaining a range of habitat types, in different stages of succession (Foster et al. 2003).

Glaciation

The Earth has experienced several glacial periods: the last, known as the Pleistocene Ice Age, began about 2 million years ago. Glaciers advanced and retreated over time as temperatures fluctuated. The most recent period to affect portions of New York was the Wisconsin Glaciation. A 1-mile thick sheet of ice, known as the Laurentide Ice Sheet, covered the region until its retreat northward. It left northern New York about 10,000 years ago (Smith 1985). As the glacier retreated, it left behind piles or layers of sediments, rocks, and other debris; known as glacial drift. These surface deposits over bedrock come in two types: glacial till and glaciofluvial. Glacial till is a mixture of sand, silt, clay, and rock ground up by the glacier and dropped as it retreated. It covers most of this region. Glaciofluvial drift develops from the transport, sorting, and deposit of material by flowing glacial meltwater. Larger gravels and stones settle out at higher gradients, while finer silts, sands, and clays settle out as the waters slow at valley bottoms (Sperduto and Nichols 2004).

Glacial Lake Iroquois formed in the area of present day Lake Ontario when the Laurentide Ice Sheet receded, but about 3 times larger. This glacial lake, along with several others, existed for thousands of years and deposited layers of silt and clay in the Hudson River Valley.

In the Finger Lakes region of New York the receding glacier left behind a series of long, narrow lakes that in time developed into extensive marshes at their shallower northern and southern ends. At the north end of Cayuga Lake, on the old bed of one of these ancient lakes, a large system of marshes developed through which the Seneca and Clyde Rivers meandered. The extensive wetlands covered an area of over 80 square miles in a northerly direction from the head of Cayuga Lake almost to Lake Ontario (USFWS 2008b).

The refuge lies within the heart of these wetland basins at the north end and the south end of the "finger lakes," intermingled with the oval-shaped hills (drumlins) region of the New York Great Lakes Plain. These elongated hills are remnants of glacial activity and are generally oriented in a north-south direction. The flat basins between the drumlin formations often provide wetland habitats.

The New York State Canal System

Although the higher elevations were logged and farmed, there were no dramatic changes to the wetlands in the Montezuma area until the development of the Erie Canal and its subsequent expansions. The Erie Canal was first proposed in 1808 and completed in 1825, linking the Hudson River in the east to Lake Erie in the west. The canal included 83 locks with a rise of 568 feet from the Hudson River to Lake Erie. A 10-foot wide towpath was built along the bank of the canal for horses, mules, oxen, and their drivers. Since it was impractical to build an aqueduct across the entire Montezuma lowlands, the canal went down into and up out of the wetlands. Once the canal was operational, the wetlands caused many problems because it was a low point, so water from both the east and west drained into the Seneca River at Montezuma (Kapell 2011 personal communication).

In hopes of changing these problems, the canal group first tried to lower the water level of the Montezuma wetlands to reduce disease occurrence and create fertile farm land. This lowering began 30 miles to the east, and over the span of nearly 75 years, the water level of the Montezuma wetlands was lowered by approximately 12 feet. In the meantime, an aqueduct and earth-fill embankment was built over part of the wetland, blocking flood flows from following their natural course to the east, down the extremely low gradient Seneca River. Also, Keuka, Seneca, and Cayuga Lakes drain into the Seneca River, which runs into the Montezuma wetland, and the eastern Finger Lakes drain into the Seneca River downstream of Montezuma, creating a massive bottleneck for high flows.

The Erie Canal was enlarged between 1836 and 1862 to handle larger boats and more traffic (Whitford 1905). But it wasn't until 1918, with the completion of the current New York State Canal System (formerly known as the New York State Barge Canal; NYS Canal System), that the Montezuma marshes were most affected. The 525-mile NYS Canal System is the successor to the Erie Canal and other canals within New York, and it crosses the Montezuma NWR in several places. It includes the Erie, Oswego, Cayuga-Seneca, and Champlain Canals. The wetlands in the refuge have been most impacted by the Cayuga-Seneca Canal, which connects Seneca and Cayuga Lakes to the Erie Canal.

The original Erie Canal was not built into the rivers and functioned like an earthen dam, stopping the flow of water from the south and therefore increasing water levels in the vast flat area of the Montezuma marshes. The marsh near the northern end of Cayuga Lake became known as the Montezuma Marsh, and shortly thereafter the entire marsh and village area were referred to by the name Montezuma (Gable 2004). When the canal was moved in the river system in 1907, the water level was lowered. Construction of the Seneca and Cayuga extension of the NYS Canal System began in 1818 and by 1828 boats passed from Geneva to the Erie Canal at the town of Montezuma. This development had minor impact on the marshes because the river system was largely unaltered.

The hydrology was further altered in 1910 when a dam and lock were constructed at the north end of Cayuga Lake. The canal system was moved into the Seneca and Clyde Rivers, which were channelized (straightened and deepened), thus functioning as huge drainage ditches for the marshes. However, they did not restore water levels in the wetlands to their original elevations. These actions lowered the level of the Montezuma marshes by 10 feet (about 3 meters) (Kapell 2011 personal communication). Therefore the Montezuma wetlands are at the mercy of the artificially managed water levels within the canal system, managed by the New York State Canal Corporation (NYS Canal Corporation).

The canals are no longer used for commercial transport, but they are popular for fishing and recreational boating and are of great historical interest.

Current Land Use

Historically, the lands at lower elevations in the vicinity of the refuge consisted of contiguous wetland habitat. Following the development of the NYS Canal System in the early 1900s these wetlands were lost, directly and indirectly, as a result of the lower water table and associated ditching, tilling, and drainage for agriculture. Currently, agriculture is the primary land use including croplands used to grow corn, potatoes, and soybeans. These lands have muck, or organic soils, derived from drained wetlands. Typically, these areas flood every spring and occasionally in the fall and winter months.

Muck soils are often favored for vegetable or root crop production due to their excellent friability and water retention capability. However, they also carry risks of flooding and are prone to subsidence due to oxidation and wind and water erosion. As these soils lose organic matter the soil pH increases. This increase in pH has a negative effect on the availability of nutrients and the suitability of the soils for growing root crops. Eventually, shallow muck soils lose their value for the production of high value crops.

Most of the upland habitat is currently maintained in early successional stages, such as grassland and shrub fields, by active management practices (USFWS 2008b). Most of the uplands surrounding the refuge are forested. These habitats are managed to improve habitat and wildlife diversity. Upland habitats adjacent to wetlands act as a buffer from the effects of crop fertilization and crop runoff (Ducks Unlimited 2000).

Regional Land Use Patterns

Much of the lands in and around the MWC are in private ownership. The majority of these lands are used for agriculture and are dominated by muck farms. The major crops are corn, potatoes, onions, beans, wheat, and hay (Ducks Unlimited 2000). Muck is the organic soil from drained swamplands, exposed across large areas when the canals were created during the height of agriculture during the 1800s through 1900s. Muck farming was an important part of farming in New York and other states. Onions, potatoes, celery, and carrots grow especially well on these soils. Maintaining mucklands in agriculture is difficult, requiring constant drainage and wind barriers, as the rich muck soils are extremely susceptible to erosion from wind (as muck becomes wind borne when dry). In addition, oxidation of the rich organic material and subsidence have substantially reduced the topsoil depth and hence lowered the fertility. On much of the muck, corn has become the primary crop because it does not require deep rich soils. Given the nature of past

muck farming practices, high levels of pesticide residues are typically found on these sites (Ducks Unlimited 2000).

The agricultural land uses surrounding the MWC contribute runoff to the wetlands. However, the function and value of some of these restored agricultural lands may have lower wetland quality if invasive plants become established or concentrations of agricultural chemicals are left undetected. The opportunity for restoring abandoned or marginal agricultural lands to high quality wetlands is great in this region.

Wetlands comprise the second largest land cover in the complex, after farmland. The most common wetland type is forested. Forested wetlands are dominated by red maple (*Acer rubrum*), silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), and swamp white oak (*Quercus bicolor*). Understory vegetation includes northern spicebush (*Lindera benzoin*), winterberry (*Ilex verticillata*), sensitive fern (*Onoclea sensibilis*), skunk cabbage (*Symplocarpus foetidus*), and arrow arum (*Peltandra virginica*). Nonforested wetlands are dominated by cattail (*Typha* spp.), purple loosestrife (*Lythrum salicaria*), and sedges and rushes (*Cyperus* spp., *Carex* spp., *Eleocharis* spp., *Juncus* spp.). Other less common wetlands include inland salt marshes and nonvegetated mudflats.

Most of the uplands surrounding the refuge are forested. These forests are characterized primarily by sugar maple (*Acer saccharum*), red maple, basswood (*Tilia americana*) and oak species (*Quercus* spp.). Grassland habitats are comprised of cool and warm season grasses and various forbes. Cool season grasslands are dominated by Timothy grass (*Phleum pratense*), smooth brome (*Bromus inermis*), orchard grass (*Dactylis glomerata*), redtop (*Agrostis gigantea*), and birds-foot trefoil (*Lotus corniculatus*). Warm season grasslands typically include switchgrass (*Panicum virgatum*), big bluestem (*Andropogon gerardii*), little bluestem (*A. scoparium*), sideoats grama (*Bouteloua curtipendula*), and Indiangrass (*Sorghastrum nutans*).

Open water surrounding the refuge consists of lakes, ponds, rivers, canals and streams that do not show emergent vegetation. Floating and submerged aquatic vegetation species may include duckweed (*Lemna spp*), coon's tail (*Ceratophyllum demersum*), waterweed (*Elodea canadensis*), water naiad (*Najas flexilis*), and pondweeds (*Potamogeton* spp.).

Ecosystem Context

Biophysical Region

The physical environment, expressed through climate, geology, topography or landform, and soils, explains much about the patterns and distribution of biological diversity. These patterns describe natural divisions, called biophysical regions or ecoregions, that inform our efforts to understand, conserve, and manage wildlife and other biodiversity. Ecoregions are relatively large geographic areas of land and water defined by common climate, geology, and vegetation patterns. The Nature Conservancy classified New York into seven ecoregions (USFWS 2008b). Montezuma NWR is in the Great Lakes Plain Ecoregion, a region formed during the last glacial advance and characterized by gently rolling, low level landscapes and flat lake plains (NYSDEC 2005a). New York has approximately 2.4 million acres of wetlands (as of the mid 1990s). The Lake Plains and the Adirondacks are the wettest portions, encompassing 74 percent of the State.

The New York State Department of Conservation (2010) estimated the percent wetland type in the Lake Plains region as forested−75.4 percent, scrub/shrub−14.2 percent, emergent marsh−7.9 percent, and open water wetland−3.3 percent.

Great Lakes Watershed

Montezuma NWR is in the southeastern corner of the 290,000-square mile Great Lakes watershed, the largest freshwater ecosystem in the world (USFWS 2008b). The watershed includes all tributary streams and inland lakes that are hydrologically connected to the five Great Lakes: Superior, Michigan, Huron, Erie, and Ontario. Together these lakes hold 20 percent of the world's supply of surface freshwater and 95 percent of the United States' supply. The climate and hydrology of the Great Lakes create unique environmental conditions that support a diversity of wildlife species and communities. The glacial and cultural history also has greatly influenced the presence and distribution of biodiversity in this region (TNC 2000).

TNC has identified several threats to biodiversity in the Great Lakes ecoregion, including development, invasive species, hydrologic alterations, incompatible forestry and agricultural practices, and resource extraction (TNC 2003). Urban, residential, second home, and road construction are causing loss, degradation, and fragmentation of important habitats. Purple loosestrife, reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), swallow-wort (*Cynanchum* spp.), garlic mustard (*Alliaria petiolata*), common buckthorn (*Rhamnus cathartica*), and zebra mussel (*Dreissena polymorpha*) are some of the invasive species negatively impacting the Great Lakes region. Dams, diversions, dikes, groundwater withdrawals, and other changes are affecting the natural flow regime of aquatic systems (TNC 2000).

Southeast Lake Ontario Basin

The refuge lies within the Southeast Lake Ontario (SELO) Basin (map 2.1) as described within the New York State Comprehensive Wildlife Conservation Strategy (NYSDEC 2005a). The New York State CWCS identified conservation priorities within the major watershed basins of the State (NYSDEC 2005a). The watershed basin boundaries are taken from the USGS 4-digit Hydrologic Unit Codes. The SELO Basin covers 4.3 million acres (all or part of 19 counties) in west central New York, from Rochester east to the mouth of Stony Creek and south encompassing the Finger Lakes. Important habitat types within the SELO include emergent marshes, riparian forests, and grasslands. According to the EPA's land classification, 50 percent of the Southeast Lake Ontario Basin is forested. The rest of the land area is dominated by agriculture, 24 percent in row crops and 16 percent in hay or pasture (table 2.1). Forty-five percent of the 1.7 million people that live in the SELO Basin are in and around Syracuse. The population of the Basin is expected to continue to decline (NYSDEC 2005a).

Table 2.1 Land Cover within the Southeast Lake Ontario Basin of New York (NYSDEC 2005a).

Land Cover Classification	Percent Cover
Deciduous Forest	34.17
Row Crops	24.38
Pasture/Hay	15.53
Mixed Forest	11.01
Water	5.01
Wooded Wetlands	3.17
Low Intensity Residential	2.57
Evergreen Forest	1.32
Parks, Lawns, Golf Courses	1.07
High Intensity Commercial/Industrial	0.79
High Intensity Residential	0.60
Emergent Wetlands	0.24
Barren; Quarries, Strip Mines, Gravel Pits	0.11

NYSDEC (2005a) identified 129 species of greatest conservation need (SGCN) that currently occur in the Basin and another 49 species that historically occurred in the Basin but are now believed to be extirpated. The State believes that within the SGCN category, populations of 43 species are decreasing, 11 are increasing, 8 are stable, and 67 are of unknown status (NYSDEC 2005a).

Western Oswego River Watershed

The MWC is a part of the 5,100-square mile Western Oswego River watershed that largely drains into Lake Ontario (USFWS 2008b). The primary surface-water is the easterly flowing New York State Canal System, located mostly within the former natural channels of the Clyde and Seneca Rivers. The MWC encompasses a 17.5-mile segment of the main canal. In an unaltered system, the water levels in the Clyde and Seneca Rivers would fluctuate according to natural weather events such as spring snowmelt/runoff, heavy spring rains/heavy runoff, and heavy fall rains before the winter freeze. However, since these rivers have been channelized as part of the NYS Canal System, the NYS Canal Corporation artificially maintains water levels for navigational purposes and to minimize flood damage within the Oswego River Basin. Typically, following the navigation season, the system's water levels are lowered in the fall to provide storage for spring snowmelt and storm runoff. The lowest water level on the system is maintained in winter. Water levels are then raised gradually to predetermined safe levels for summer use. Other waterways in the MWC include Black Brook, White Brook, and Crusoe Creek.

Map 2.1. Southeast Lake Ontario Basin.

Bird Conservation Region

As discussed in chapter 1, "Conservation Plans and Initiatives Guiding the Project," Montezuma NWR lies within BCR 13, the Lower Great Lakes/St. Lawrence Plain (map 2.2). BCR 13 encompasses the vast, low-lying lake plain region surrounding Lake Erie and Lake Ontario, the St. Lawrence River Valley, low-lying regions between the Adirondack Mountains and the Laurentian Highlands, and upper regions of the Hudson River Valley. In addition to important lakeshore habitats and associated wetlands, this region was originally covered with a mixture of oak-hickory, northern hardwood, and mixed-coniferous forests. Although once dominated by forests, the landscape currently is largely agricultural with interspersed wetlands and remnant forest stands. At one time or another, nearly 95 percent of the original habitat types have been logged or converted to agriculture and/or urban development. BCR 13 was identified as playing a critical role in providing important staging and migrating habitat for birds during the spring and fall migration (ACJV 2007). In addition, about 16 percent of the global population of bobolink (*Dolichonyx oryzivorus*) nests in the St. Lawrence Valley of northern New York (Rosenberg 2000).

Agriculture has been the major land use in BCR 13 for nearly 300 years. Today, this farmland matrix contains scattered remnant forest and patches of wetlands and is interspersed with towns and several large metropolitan areas. Within BCR 13, the agricultural lands comprise over 15 million acres (30 percent of the total land area) while hay and pasture (10 million acres) account for 21 percent of the total area. Approximately one third of BCR 13 is now covered with upland forest, consisting of deciduous (21.8 percent), mixed (8.6 percent), and coniferous (3.4 percent) stands. Urban areas make up 5 percent of the land area, and the remaining land cover consists of open water (5.5 percent), forested wetland (2.6 percent), and less than 1 percent open wetland (ACJV 2007). Heinselman (1981) describes the presettlement BCR 13 region as a forest belt, transitioning between the boreal forests of Canada and the deciduous forests of the eastern U.S.

Historically, the St. Lawrence River Valley was dominated by sugar maple-beech-birch forest, mesic oak hardwood forest, red maple-black ash swamp forest, and silver maple floodplain forest (Rosenberg et al. 2000). The Lower Great Lakes Plain consisted primarily of either northern hardwood forest or dry oak-hickory-ash forest (Dettmers and Rosenberg 2003). Historic nonforest natural vegetation types of the region include pitch pine-scrub oak woodlands, emergent freshwater marshes, and freshwater tidal marsh, as well as large river islands with beds of reeds or grass (including wild rice) (Rosenberg 2000).

Partners in Flight Physiographic Regions

In 1990, Partners in Flight was established as a means to promote cooperative conservation to address bird and habitat issues at a continental scale. The refuge lies within Area 15, the Lower Great Lakes Plain (LGLP) physiographic area, which encompasses approximately 11,788,162 acres (map 2.3). LGLP covers the low-lying areas to the south of Lake Ontario in New York and to the north of Lake Erie in southernmost Ontario in Canada. In addition to important lakeshore habitats and associated wetlands, this region was historically covered with a mixture of oak-hickory, northern hardwood, and mixed-coniferous forests. Roughly 74 percent of the land area is in agricultural production. In addition, several medium-sized cities (Syracuse, Rochester, Buffalo, Windsor, etc.) comprise over 800,000 acres of urban land, or 7.1 percent of the

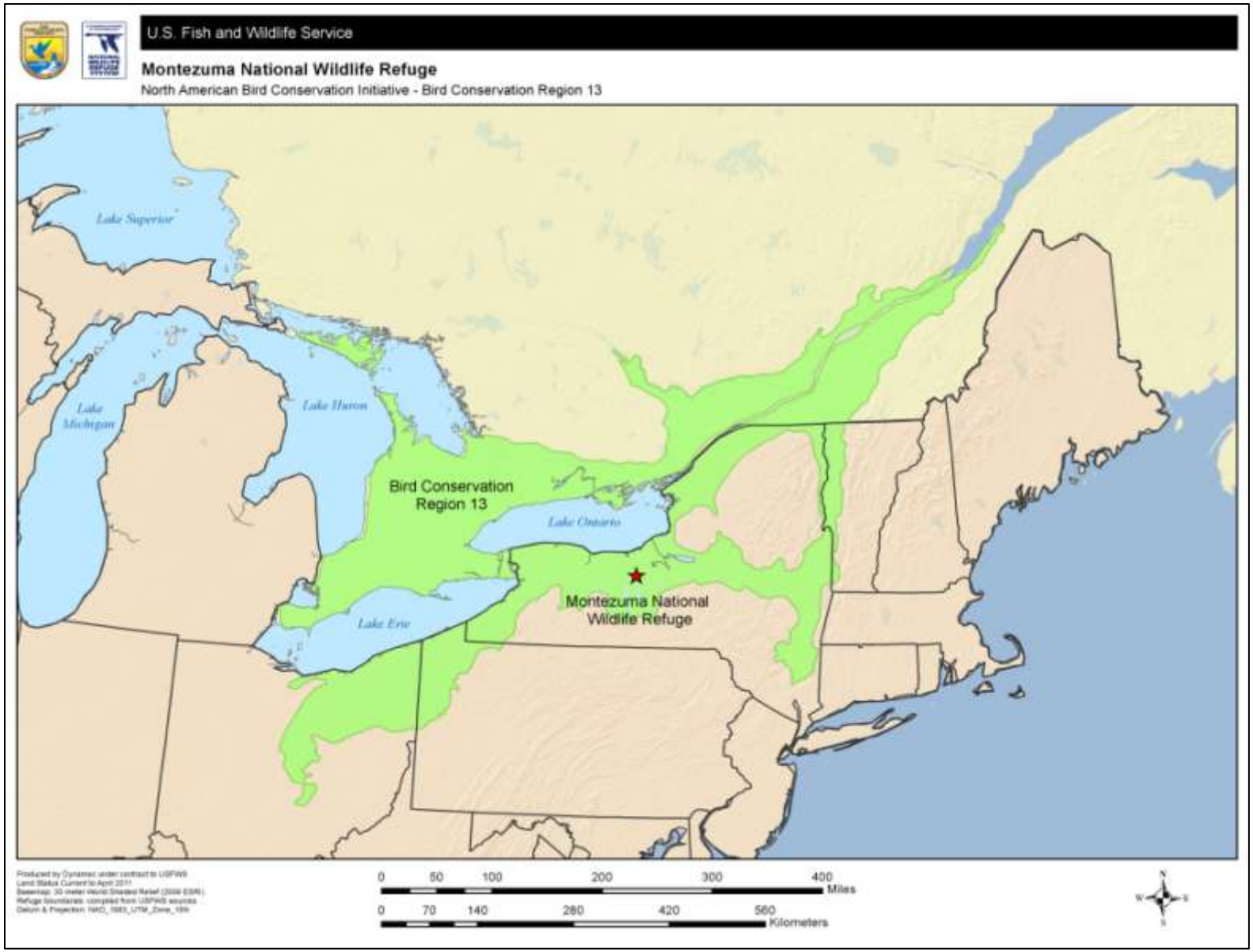
physiographic area. Priority bird species of the LGLP include Henslow's sparrow (*Ammodramus henslowii*), bobolink, upland sandpiper (*Bartramia longicauda*), golden-winged warbler (*Vermivora chrysoptera*), American woodcock (*Scolopax minor*), cerulean warbler (*Dendroica cerulean*), and red-headed woodpecker (*Melanerpes erythrocephalus*). Specific conservation recommendations for this physiographic area include

- intensive survey and monitoring for high-priority species to identify most important areas in need of protection;
- increased protection of forest and lakeshore habitats critical to cerulean warblers and migrant passerines;
- increased management on protected and private lands to provide habitat for Henslow's sparrow and golden-winged warbler; and,
- integration of land bird population and habitat objectives with those for wetland species and game species such as American woodcock.

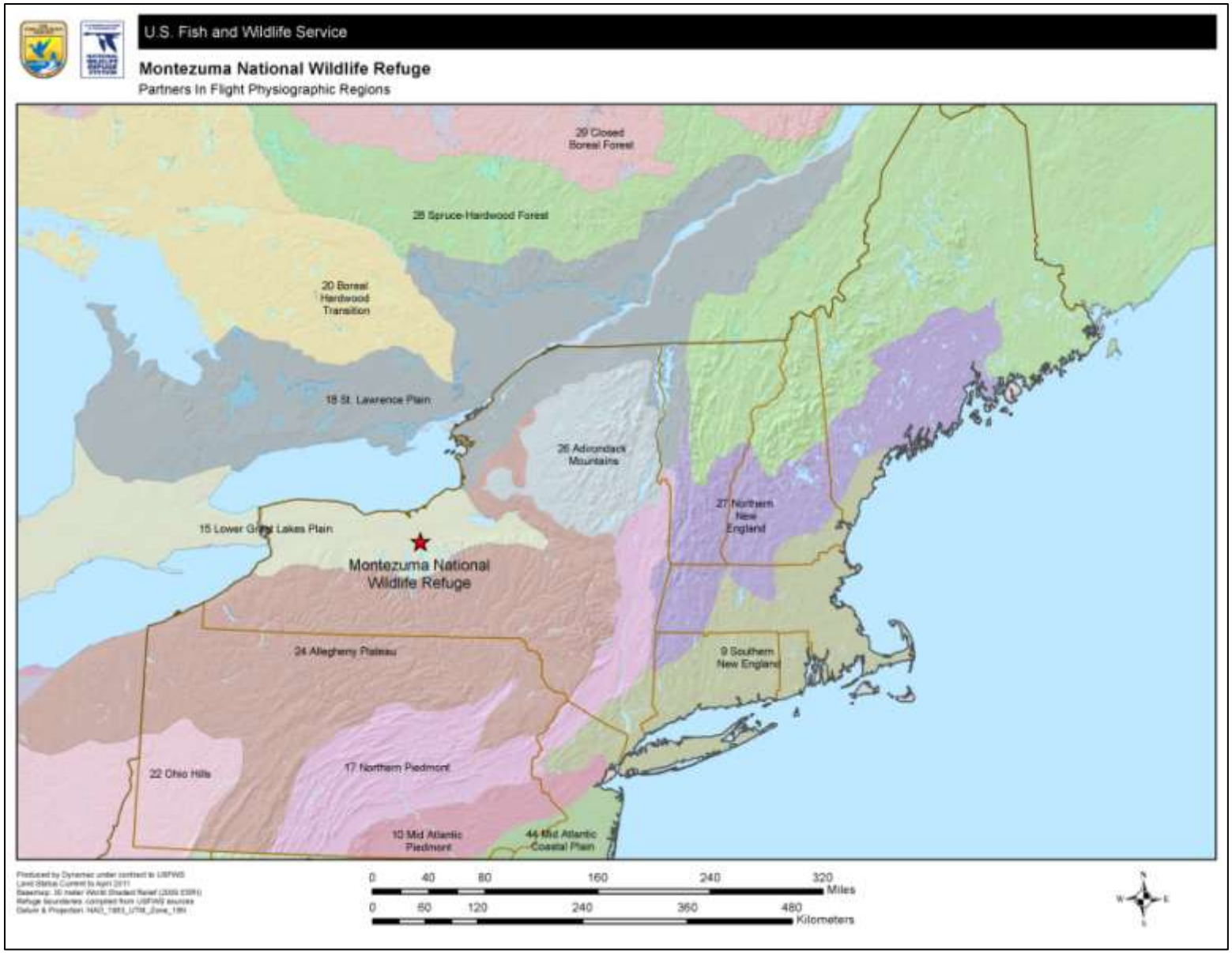
Ecological Role of Fire in the Region

Wildfire has not played a major role as a natural disturbance in shaping the ecosystems of BCR 13, with the possible exception of certain uncommon habitats, such as open grasslands, shrublands, or savannah found on rocky barrens (e.g., limestone bedrock) or other areas with shallow, drought-prone soils. Brown and Smith (2000) estimate that historically the region was subjected mainly to mixed severity fires (i.e., fires which vary between understory and stand replacement impacts, or cause selective tree mortality) at intervals of greater than 500 years. Runkle (1990) indicates in a generalized scheme for the Eastern U.S. that the historic, major disturbance in the deciduous forest of the Great Lakes region were "gaps" (mainly single tree death), rather than frequent wildfires or large wind events.

Therefore, the role of fire in restoring historic ecological conditions, such as on a large-scale in forested, wilderness areas, is limited in BCR 13. Prescribed fire is more appropriately used on national wildlife refuges in BCR 13 for small-scale habitat manipulation. Refuges in the region have primarily used prescribed fire to manipulate vegetation in freshwater impoundments and post-agricultural, successional habitats (USFWS 2009a).



Map 2.2. Bird Conservation Region 13.



Map 2.3. Partners in Flight Physiographic Regions.

Climate

The weather in the Great Lakes watershed is affected by the location and size of each lake, air masses from other regions, and the location within a large continental landmass. Each of the Great Lakes acts as a heat sink, absorbing heat when the air is warm and releasing it when the air is cold. This results in more moderate temperatures at areas near the shore than other locations at similar latitudes. The influence of external air masses varies seasonally. In the summer, the region is influenced mainly by warm humid air from the Gulf of Mexico, whereas in winter the weather is influenced more by Arctic and Pacific air masses (USEPA and Government of Canada 1995).

Lake Ontario provides the source of significant winter precipitation as it is very deep and almost never freezes. Cold air flowing over the lake is quickly saturated and produces the cloudiness and "lake effect" snow squalls that are well-known features of winter weather in the vicinity of the refuge. Snowfall is moderately heavy, with an annual average of approximately 66 inches. Wind velocities are moderate, but during winter months there are numerous days with sufficient winds to cause severe blowing and drifting of snow. The refuge area is generally cold and snowy in winter with an average temperature of 27 degrees Fahrenheit (°F) and an average low of 19 °F (see table 2.2). Summers are generally warm with an average temperature of 67 °F and an average high of 80 °F. Average annual precipitation is 36 inches and is well-distributed during the year (National Oceanographic and Atmospheric Administration [NOAA] 2010a).

Table 2.2. Average Temperature and Precipitation for 1971 to 2000 Around Auburn, New York (Source: NOAA 2010a).

Month	Temperature Averages for Auburn, NY 1971- 2000		50-Yr Average Precipitation Inches
	Average High (°F)	Average Low (°F)	
January	31	14	1.39
February	34	16	1.26
March	44	24	2.26
April	56	35	2.97
May	72	47	3.04
June	77	55	3.36
July	81	60	3.48
August	79	58	3.28
September	79	51	3.53
October	59	40	3.23
November	48	32	3.22
December	35	20	1.98
Average Totals	**57**	**38**	**32.98**

Climate Change

Secretarial Order 3226 (Amendment 1) requires that climate change impacts be considered and analyzed when planning or making decisions within the Department of the Interior (U.S. Secretary of the Interior 2009). This order serves as an opportunity for refuge system planners and managers to incorporate climate change impacts into each refuge's CCP.

There is consensus among the scientific community that global climate change, occurring in part as a result of emissions of carbon dioxide and other greenhouse gases from human activities, will lead to significant impacts across the U.S. (Wigley 2004). These may include increasing temperatures, altered rainfall patterns, and sea level rise. The effect of climate change on wildlife and habitats is expected to be variable and species specific, with a predicted general trend of ranges shifting northward and to higher elevations (Shugart et al. 2003). Nonnative species will likely increase (Walther et al. 2002). Within the Great Lakes region, substantial changes are anticipated, and according to a regional report on projected climate change and impacts, by 2025, spring and summer temperatures in the Great Lakes region are likely to be 3 to 4 °F above current averages (Kling et al. 2003). The amount and seasonal distribution of precipitation is expected to be altered as well; precipitation is expected to increase between 10 and 20 percent, with winter and spring rain increasing and summer rain decreasing by up to 50 percent. These changes in precipitation may result in more frequent floods and droughts. Uncertainty about the future effects of climate change requires refuge managers to use adaptive management (e.g., adjusting regulations, shifts in active habitat management, or changing management objectives) to maintain healthy ecosystems in light of unpredictability (Inkley et al. 2004). Refuge managers can plan and respond to changing climate conditions. Options include managing for diverse and extreme weather conditions (e.g., drought and flood); maintaining healthy, connected, genetically diverse wildlife populations; and (where applicable) protecting coastal wetlands to accommodate sea level rise (see Inkley et al. 2004 for more recommendations).

Hydrology

The refuge receives water from direct precipitation, runoff from the hilly areas bordering the west side of the refuge, three streams originating to the west of the refuge, and several springs within refuge boundaries. Two streams, Black Brook and White Brook, flow directly into Tschache Pool. Black Brook is the major contributor to this impoundment with a drainage area of 12,580 acres. White Brook has a drainage area of 5,760 acres. Esker Brook, with a drainage area of 2,090 acres, flows into North Spring Pool (USFWS undated).

The refuge includes a salt spring located in Black Lake within the Main Pool. Inland salt marshes are globally endangered plant communities (Eallonardo 2009 personal communication). The Black Lake Salt Marsh, one of four in the MWC, was identified by Weigand and Eames in 1925 and is listed as a rare community by the New York Natural Heritage Program.

Surface water concerns include water quality, artificially maintained water levels generated by the operation of the NYS Canal System and surface water supply for current and future wetland impoundments. Ground water resources in the MWC are located in the consolidated (bedrock) and unconsolidated glacial deposits. Nearly all the ground water in this area is derived from precipitation that is absorbed by the bedrock. Unconsolidated sand and gravel deposits produce

the best yield of water for wells in the region. Overall, hydrological data for the MWC is lacking, and more detailed information is needed (Ducks Unlimited 2000).

Geology and Topography

Post-glacial geologic features dominate the landscape surrounding the refuge. The topography is represented by formations such as drumlins, eskers, kames, and kettles, and is gently sloping to rolling. The refuge lies over an old, flat lakebed at the northern end of the Cayuga Lake Basin. The broad, flat basins are interrupted by classic drumlin formations, oblong hills of 60 to 150 feet high with a north-south orientation resulting from glacial deposits. The flat basins below the 380-foot contours are the location of the existing and historical Montezuma Marshes (Ducks Unlimited 2000).

Soils

The refuge region is generally underlain by a combination of limestone and limestone/shale bedrock. These calcareous rocks result in the highly productive glacial till found throughout the Montezuma wetlands area. Three major soil groups are found within the MWC. The largest group is comprised of various types of muck (lake bottom and marsh organic materials) occurring at or below the 380-foot contour interval. The Ontario soil association in the drumlin zones and the Odessa-Schoharie Fulton-Lucal association found in the southwestern corner of the MWC characterize the remaining area (Ducks Unlimited 2000).
A soil profile of the refuge wetlands would reveal an upper layer of deep Carlisle muck and sedimentary peat over a Chara and shell marl. The subsoil in this area of the old lake basin is compact blue clay. The upland soils are derived from calcareous glacial till. The well-drained sandy loams include pockets of Palmyra gravelly loam, Ontario loam, Poygan silty clay loam, Schoharie silty clay loam, and Wayland silty loam (U.S. Department of Agriculture [USDA] Soil Conservation Service and Cornell University Agricultural Experiment Station 1972). Table 2.3 lists refuge soils.

Table 2.3. Soil Types on Montezuma NWR.

Soil Symbol	Soil Name	Description
CeB	Cazenovia silt loam (3 to 8 percent slopes)	Moderately well-drained, medium textured, and moderately fine textured soils that formed in glacial till having a high content of clayey shale and in calcareous glacial till in which a deposit of lacustrine clay has been incorporated.
CIA	Collamer silt loam (0 to 2 percent slopes)	Moderately well-drained, medium textured soils that formed in lacustrine deposits of alkaline or calcareous silt or very fine sand that is high in content of silt.
Ed	Edwards muck (level or nearly level)	Organic soils that formed in mixed woody, grassy or sedgy material underlain by white to light gray calcareous marl at a depth of 10 to 40 inches.
Fn	Fonda mucky silty clay loam (level or depressional)	Very poorly drained, moderately fine textured soils that developed in lacustrine deposits of gray, brown, or reddish, calcareous clay containing occasional bands of silt and very fine sand.
LcA	Lakemont silty clay loam (0 to 2 percent slopes)	Poorly drained, moderately fine textured soils that formed in calcareous, reddish, lacustrine clay and silty clay.

Soil Symbol	Soil Name	Description
LtB	Lima silt loam (3 to 8 percent slopes)	Deep, moderately well-drained soils that formed in strongly calcareous, medium textured glacial till.
Ma	Madalin and Odessa silty clay loam (level or depressional)	Deep, poorly drained soils that formed in calcareous, gray and brown clay and silty clay in glacial lakes.
Md	Made land, tillable	Areas in which the original soil has been moved or disturbed, and the original surface layer and subsoil are not evident. Most areas consist of material that was dredged during the straightening and deepening of the NYS Canal System.
Mr	Muck, deep (0 to 1 percent slopes)	Organic soil formed in a mixture of wood, grass, or sedgy material; strongly acid to alkaline; the organic layer ranges from 40 inches to as much as 17 feet in depth. The organic layer is underlain by mineral soil material or by white, highly calcareous marl.
Ms	Muck, shallow (0 to 2 percent slopes)	Organic soil formed in a mixture of wood, grass, or sedgy material; strongly acid to alkaline; the organic layer ranges from 10 to 40 inches in depth.
OdA	Odessa silt loam (0 to 2 percent slopes)	Deep, somewhat poorly drained soils that formed in calcareous, reddish, lacustrine clay and silt.
OnB	Ontario loam (2 to 8 percent slopes)	Deep, medium textured, well-drained soils that formed in strongly calcareous, firm glacial till. The glacial till is derived mainly from sandstone, limestone, and some shale, and contains sufficient red sandstone or red shale to impart a reddish hue.
OnC	Ontario loam (8 to 15 percent slopes, eroded)	Commonly occurs in long, narrow strips on the sides or tops of drumlins. Seventy-five percent of most areas are so eroded that the surface layer consists partly of material from the subsoil.
OnD	Ontario loam (15 to 28 percent slopes, eroded)	Typical for the Ontario series but is generally thinner over calcareous till. These soils typically occur on the sides of drumlins. Most of the slopes are single, although a few are hilly and complex.
OvA and OvB	Ovid silt loam (0 to 3 percent slopes and 3 to 8 percent slopes)	Deep, somewhat poorly drained soils that have a moderately fine textured subsoil. These soils formed in reddish glacial till derived from mixed limestone and red alkaline or calcareous clay shale or from appreciable amounts of reworked red lacustrine clay mixed with limestone and shale.
SeB	Schoharie silt loam (2 to 6 percent slopes)	Deep, moderately well-drained and well-drained soils derived from calcareous reddish clay and silt. The surface layer is commonly silt loam, but there are a few small areas of very fine sandy loam.
Sn	Sloan silt loam (level or depressional)	Deep, poorly drained and very poorly drained, medium textured and moderately fine textured soils that form in slightly acid to mildly alkaline, recent alluvium. These soils typically have little or no structure.
Source: USDA Soil Conservation Service and Cornell University Agricultural Experiment Station 1972		

Air Quality

The EPA collects emissions data for three air pollutants—carbon monoxide, sulfur dioxide, and particulate matter—and three precursors/promoters of air pollutants—volatile organic compounds, nitrogen oxides, and ammonia. That data are summarized in the Air Quality System database, the EPA repository of air pollutant monitoring data, which reports the number of days when air quality was good, moderate, unhealthy for sensitive groups, or unhealthy (for everyone), by counties with air quality monitoring stations. We are using data for Wayne County, the nearest county which monitors air quality, for a general evaluation of air quality at the refuge. The following data were collected in 2008: Wayne County—89 percent good, 10 percent moderate, and 1 percent unhealthy for sensitive groups (0 unhealthy days) (EPA 2008).

Water Quality

The Finger Lakes of New York are essential to the health, well-being, and economy of the region. It is estimated that these lakes contain 8.1 trillion gallons of freshwater. Combined, their watersheds are 2,630 square miles (Halfman and O'Neill 2009). These lakes are a source of Class AA drinking water to the 1.5 million residents in the surrounding communities. Water quality varies across the Finger Lakes. Skaneateles, Canandaigua, and Keuka Lakes are oligotrophic and have the best water quality. Seneca, Owasco, Cayuga, Honeoye, and Otisco Lakes are mesotrophic to eutrophic and have lower levels of water quality. Nutrient sources in the watershed stem from both point and nonpoint sources, including wastewater treatment facilities, erosion along stream banks, and agricultural runoff (Halfman and O'Neill 2009). Water quality issues of concern within the Finger Lakes include water supply, swimming, and fish consumption. Among pollutants of concern are nutrients, sediments, priority organics, pathogens, and salts (Callinan 2001).

The refuge is closest to Cayuga Lake, the second largest of the Finger Lakes in volume, and has the largest watershed. The lake is 38.2 miles in length, has a maximum width of 3.5 miles, and contains 95.3 miles of shoreline. The drainage basin is 785 square miles. Cayuga Lake drains through the Oswego River system into Lake Ontario. The quality of water in Cayuga Lake is dependent on the quality of water that enters it from tributaries and runoff within the watershed. Cayuga Lake is subject to contamination from both point and nonpoint sources that may enter the lake through runoff from tributaries or directly into the lake itself (Genesee/Finger Lakes Regional Planning Council and EcoLogic 2000).

Recommendations for Cayuga Lake include: (1) control of nutrient (particularly phosphorus) and sediment loads within the Cayuga Lake watershed; (2) continuation of periodic monitoring of aquatic biota for chlorinated organic chemicals; and (3) monitoring zebra mussels to understand population dynamics and assess the ecological effects associated with this invasive exotic species (Callinan 2001).

Environmental Contaminants

A 1995 draft report summarized the existing contaminant information related to Montezuma NWR (USFWS 1995). This summary included a list of baseline studies, nearby hazardous waste sites, monitoring sites, and history of pesticide use on the refuge. The Service also has been acquiring mucklands from willing sellers for restoration of wetland and upland habitats in the MWC. Some surveys of these lands have detected the presence of contaminants.

Stoll (1988) sampled water quality, sediments, and wildlife species within refuge impoundments and adjacent canals and streams to determine the presence and extent of contaminants. Dichlorodiphenyltrichloroethane (DDT), Polychlorinated Biphenyls (PCBs), and dieldrin were found in turtle and fish tissue samples. Although these compounds were not detected in sediment samples, these chemicals and other pesticides were found in samples from some refuge tracts, such as the Sandhill Crane Unit (USFWS 1999). It was concluded that levels of metals and organics were not a cause for concern, although there is some evidence that adverse effects to ecosystem function are occurring and levels of arsenic, zinc, and copper in agricultural mucklands were above baseline conditions and in some place above the State's "severe effect" level (USFWS 1999). Contaminant uptake by wildlife is dependent on the contaminant, the other contaminants present, the species involved, and the chemistry of the soil and water (NYSDEC 1998). Soils with a high carbon content and large proportions of fines in sediments (such as in the mucklands) can bind a higher amount of contaminants and therefore have a higher capacity of limiting the amount of contaminants available for uptake by wildlife. Thresholds suggested by Long and Morgan (1990) may be more applicable to the mucklands than the Statewide thresholds. The cumulative concentrations of arsenic, copper, and zinc show some correlation with a decrease in algae species richness (USFWS 1999). To reduce the potential exposure of trust resources to contaminants, a management strategy was drafted for muckland restoration and acquisition related to contaminant issues (USFWS 1999).

Noise

The presence of high- and low-speed roadways scattered throughout the refuge results in some traffic noise being within hearing distance of many refuge areas. Ambient noise levels on and around the refuge are generally similar to other rural locations in central New York except for along Interstate 90. The effect on wildlife from the noise generated on the NYS Thruway is believed to be minimal due to its relative uniformity of volume and timing, although it negatively affects visitors. Most areas on the refuge (e.g., Knox-Marsellus, Esker Brook Trail) are sufficiently buffered from noise to allow visitors a pleasant experience.

Visual Resources

The refuge offers an excellent option for central New Yorkers seeking an aesthetically pleasing landscape to visit. There is much to be gained from experiencing a picturesque sunrise or sunset over the grasslands and marshes of Montezuma NWR. The abundance and diversity of wildlife associated with these open spaces significantly enhances the outdoor experience.

Transportation and Utility Corridors

The refuge is intersected or adjacent to several major roads and utility corridors. The NYS Thruway crosses the refuge at the Main Pool impoundment. In addition, several State highways, as well as numerous county and town roads run through or along refuge lands. Two railroads

operate in the area, and the NYS Canal System and the Cayuga-Seneca Canal are two major waterway transportation routes through the area. Utility corridors that transverse or border refuge lands include four power lines (over 115 Kilo volt), three major underground telephone lines, and several oil and gas pipelines.

Biological Environment

Habitat Types

The refuge supports the following habitats: emergent marsh, open water, mudflat, forested wetland, upland forest, grassland, and early successional uplands and wetlands (table 2.4 and map 2.4.

Table 2.4. Habitats on Montezuma NWR.

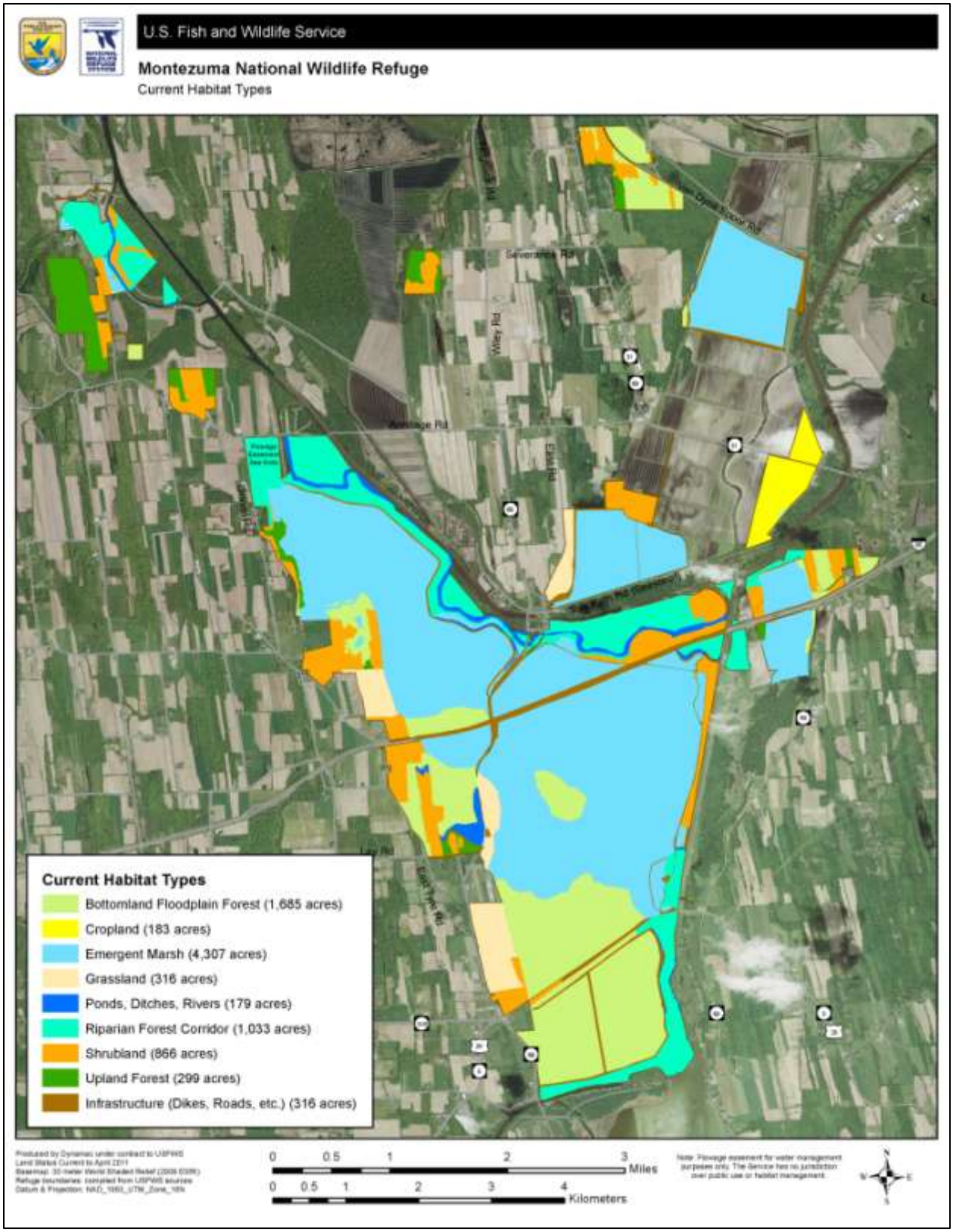
Habitat Type	Acres	Percent
Emergent Marsh	4,307	46.9
Bottomland Floodplain Forest	1,685	18.3
Riparian Forest Corridor	1,033	11.2
Scrub/Shrub	866	9.4
Upland Forest (all successional stages)	299	3.3
Cropland	183	2.0
Grassland	316	3.4
Ponds, Ditches, Rivers	179	1.9
Infrastructure (dikes, facilities, trails, etc.)	316	3.4
Total	**9,184**	**100.0**

Wetlands

The three major types of wetlands at Montezuma NWR, according to Cowardin et al. (1979), are aquatic bed, emergent wetland, and forested wetland. Aquatic bed refers to wetlands and deepwater habitats that are dominated by plants which grow primarily on or below the water surface. Emergent wetlands are characterized by rooted herbaceous hydrophytes and usually occur in calm, shallow water. Forested wetlands are dominated by various water-tolerant tree species, with minimal understory. These habitat types provide numerous benefits, including flood protection by acting as sponges which absorb excess water; improved water quality by filtering toxins introduced by agricultural runoff; and diverse habitat for wildlife (EPA 2001).

Emergent Marsh, Open Water, and Shallow Water/Mudflats

The most common habitat type on the refuge is emergent marsh. Emergent marsh is a wetland dominated by erect herbaceous plants such as cattails and smartweeds (*Polygonum* spp.). Historically, habitat conditions in these marshes were dictated by the weather, which influenced water levels and flow rates in the Seneca and Clyde Rivers. For example, a particularly wet



Map 2.4. Montezuma National Wildlife Refuge Current Habitat Types.

season or a series of wet years, would have resulted in higher water levels in the marshes and more open water relative to vegetative cover. Similarly, a drought year would have resulted in lower water levels and more vegetative growth. The Seneca and Clyde Rivers have since been dredged and straightened and continue to drain the historic marshes. The water levels and flow rates are largely controlled by the NYS Canal Corporation rather than natural fluctuations. This control has a consequence of moderating the variation and timing of high and low water. As a result, habitats within the refuge would develop into more forested wetlands and uplands, and less emergent marsh due to the lack of periodic flooding. It is for this reason that wetlands on the refuge are impounded and refuge staff manipulate the water levels. The impounded wetlands are managed to mimic natural hydrologic fluctuations and provide optimal habitat for species of conservation concern.

This effort began in the late 1930s, when the U.S. Bureau of Biological Survey (the precursor to the U.S. Fish and Wildlife Service) began acquiring the southern portion of the Montezuma Marsh. Shortly after Montezuma NWR was established in 1938, the Civilian Conservation Corps began work on a series of low dikes to reflood the main marsh (now called the Main Pool). In 1939, diking operations were continued to impound the flows of White and Black Brooks, to reflood a small portion of the former marshes, and to create a water source to refill the Main Pool, thus creating Tschache Pool. Today, the refuge has 14 manageable impoundments totaling more than 4,000 acres of freshwater emergent marsh, open water, and mudflat habitat (table 2.5 and map 2.5).

Table 2.5. Emergent Marsh and Open Water/Mudflat Impoundments on Montezuma NWR.

Impoundment Name	**Acres**
Main Pool	1,657
Tschache Pool	1,160
Sandhill Crane Unit	448
Knox-Marsellus Marsh	236
Jackson	215
May’s Point Pool	199
Puddler Marsh	98
North Spring Pool	91
Millennium Marsh	69
Visitor Center Wetland	26
Benning Marsh	18
Shorebird Flats	18
Box Elder Bog	10
Lesser Yellowlegs Unit	8
Display Pool	2
Total	**4,255**

This dike system allows us to maintain many of our marsh units at “flood” stage for long periods and through a range of weather conditions. However, biologists have learned that after prolonged high water, emergent vegetation dies back and open water dominates. At this stage of the marsh’s life, it is less productive and provides little habitat for wildlife (e.g., waterfowl,

marshbirds, shorebirds, muskrats). Draining the water out of the marsh at this time mimics a natural drought, exposes mudflats for shorebirds during their migration if timed properly, and allows plants to grow. When the marsh is reflooded, the resulting habitat is ideal for a variety of wildlife. Annual moist-soil vegetation is an important food source for migrating waterfowl, and perennial vegetation provides important cover not only for waterfowl but also for breeding marshbirds, such as rails, bitterns, and terns.

Forested Wetlands (Bottomland Hardwoods)

Bottomland hardwoods comprise 1,685 acres at Montezuma NWR. Most of the forest on Montezuma NWR is forested wetland. Dominant vegetation includes red and silver maple, American elm (*Ulmus americana*), green ash, and swamp white oak. The understory is sparse, and includes common winterberry, northern spicebush, and highbush blueberry (*Vaccinium corymbosum*). These understory shrubs are largely confined to hummocks. Species common to the transitional zones between hummocks and vernal pools include sensitive fern, marsh fern (*Thelypteris palustris*), skunk cabbage, and false nettle (*Boehmeria cylindrical*) (Ducks Unlimited 2000).

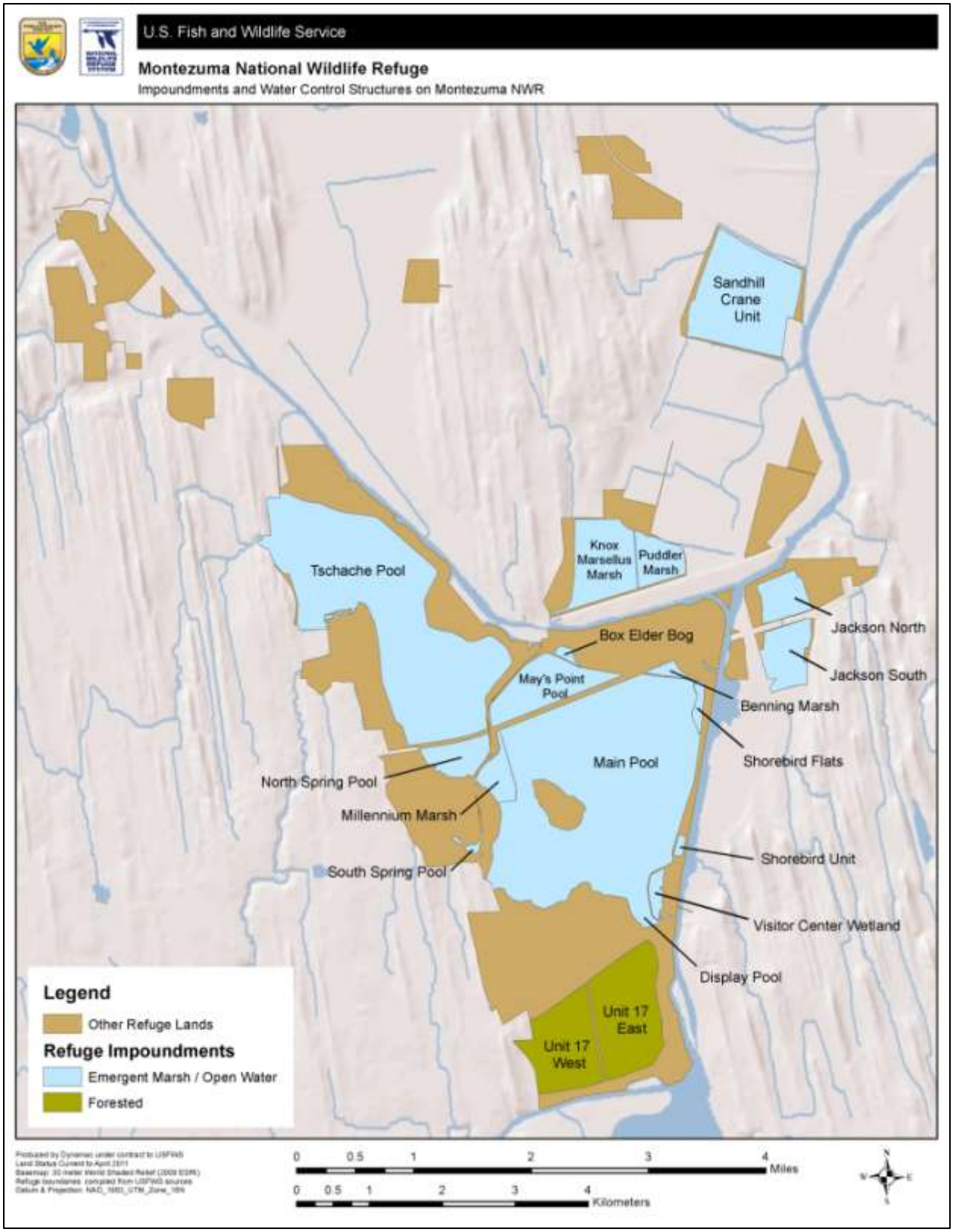
The largest stand of forested wetland on the refuge includes two green tree reservoirs, the 344-acre Unit 17 East and the 266-acre Unit 17 West, collectively called Unit 17. Unit 17 is south of Routes 5 and 20 and separates the northern terminus of Cayuga Lake from the extensive emergent marsh system on the refuge. The Service created these two green tree impoundments in 1965 to benefit nesting, resting, and feeding waterfowl. Flooding of these impoundments was terminated in 1977 because extended flooding into the growing season resulted in damaging the overstory (USFWS 2008b). Long periods of managed flooding stressed mature trees and prevented germination and survival of seeds and seedlings. Water level management now focuses on more closely following a natural hydrologic period for a bottomland forest community in this region.

Uplands

Most of the upland habitat on Montezuma NWR is maintained in an early successional stage (grassland or scrub-shrub fields) through active management. Succession is set back in these areas through a variety of management techniques, including mowing, burning, disking, planting, hydroaxing, and chemical treatment.

Grasslands

The refuge maintains four grassland units totaling 316 acres to support grassland-dependent species. These units support warm season grasses, cool season grasses, some forbs, small shrubs, and some woody species. These fields require long-term maintenance including frequent mowing, herbicide applications, and prescribed burning to control invasive plants and other nondesirable plants including woody shrubs. Common plant species include Timothy grass, smooth brome, reed canary grass, Canada thistle (*Cirsium arvense*), goldenrod (*Solidago* spp.), switchgrass, big bluestem, and Indiangrass.



Map 2.5. Impoundments and Water Control Structures on Montezuma NWR.

Shrublands

Refuge shrublands are diverse from location to location with dominant plants including goldenrod, gray dogwood (*Cornus racemosa*), Morrow's honeysuckle (*Lonicera morrowii*), and common buckthorn. Only two tracts on the refuge are actively maintained in this early successional state. Other shrubland areas will need to be managed to set back succession.

Forests

Upland forested sites are mostly successional forests dominated by black walnut (*Juglans nigra*), black willow (*Salix nigra*), and green ash occurring on former agricultural fields. Most of the mature forested sites on the refuge are wetlands. However, good examples of mature upland forest sites include the Beech-Maple Knoll Research Natural Area, the upland portions of the Cerulean Forest, and the 176-acre Nash Forest (refer to USFWS 2008b for more details). These sites require little to no maintenance but should be monitored for invasive plants and deer impacts.

Croplands

Newly acquired farmlands are frequently enrolled in the refuge's cooperative farming program to provide a smoother transition for both the farmer and the refuge. This is a means to keep fields open and relatively free of invasive plants in preparation for conversion to native plants. Cooperative farmers are not allowed to plant potatoes, as they require large amounts of herbicides, fungicides, and pesticides. With prior approval, farmers are permitted to apply fertilizers and herbicides, but genetically modified crops are prohibited.

Cooperative farmers provide other in-kind services including:

- Mowing refuge grasslands to prevent brush encroachment.
- Seeding refuge fields.
- Plowing, disking, and cultipacking upland fields prior to planting permanent grass cover.
- Purchasing grass seed for planting in refuge upland fields.
- Maintaining the tops and slopes of dikes.

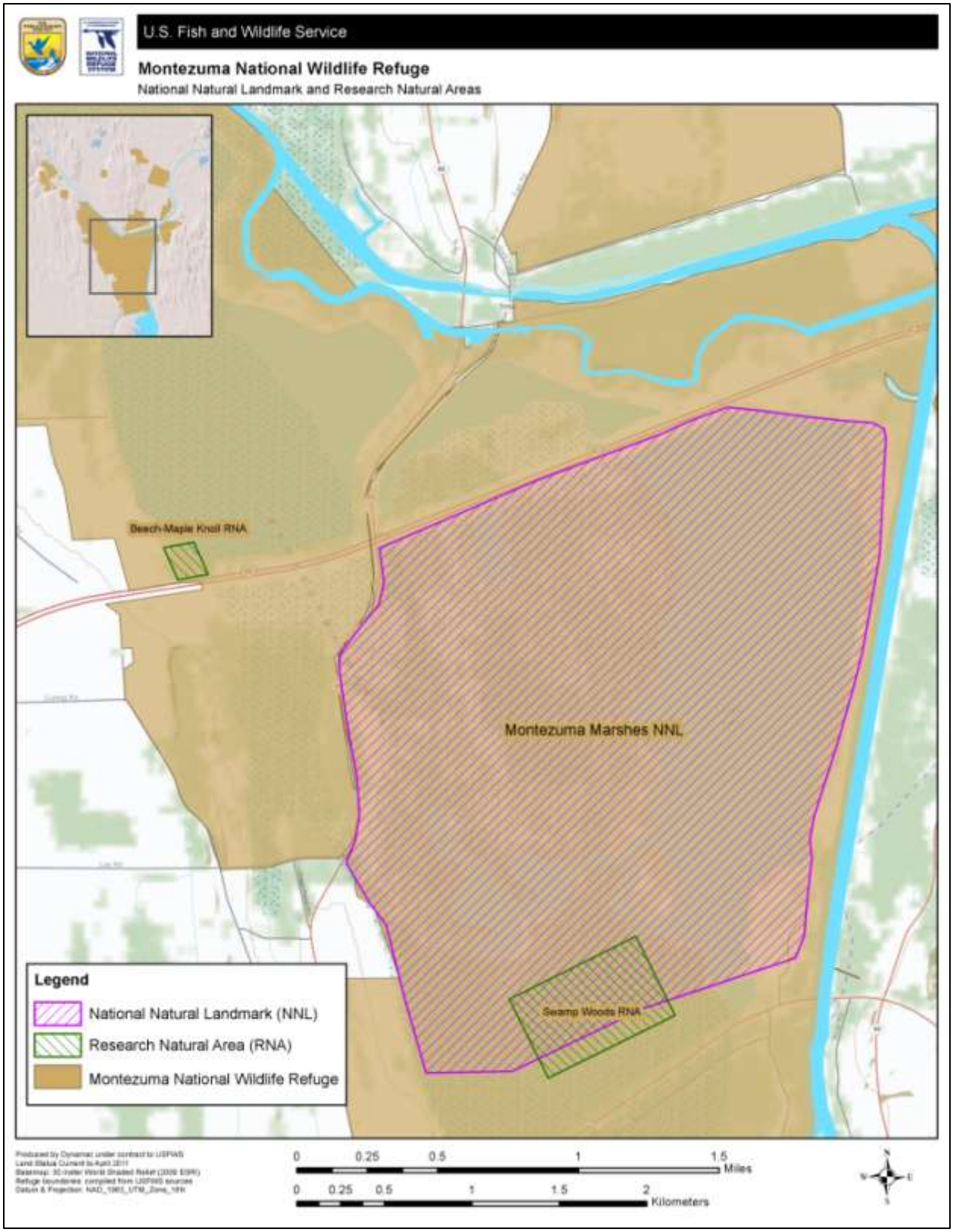
Special Designations

Special designations on the refuge include Research Natural Areas (RNAs) and a National Natural Landmark (NNL). Currently, the refuge does not contain designated wilderness.

Research Natural Areas

The refuge has two designated RNAs (map 2.6), approved in 1967. The Beech-Maple Knoll RNA is an 8-acre tract located southwest of Tschache Pool. A prime example of a mature, northern hardwood beech-maple forest cover type, the beech-maple association provides a unique habitat type not found elsewhere on the refuge. Unfortunately, regeneration of this cover type has been negatively impacted by heavy deer browsing in this area (Rawinski 2010 personal communication).

The Swamp Woods RNA is a tract of approximately 100 acres located southwest of the Main Pool. It is an unusual stand because it is the last remaining undisturbed example of swamp woodland on the refuge. It was once the common woodland type found on muck soils throughout the historic Montezuma marshes, but has now become rare due to draining and clearing of



Map 2.6. Montezuma National Wildlife Refuge National Natural Landmark and Research Natural Areas.

muckland for farming. The vegetation of interest includes black ash (*Fraxinus nigra*), American elm, red maple, and white oak (*Quercus alba*).

National Natural Landmark

In 1973, a 2,100-acre portion of the refuge was designated as the Montezuma Marshes NNL by the National Park Service under the provisions of the Historic Sites Act of 1935 (map 2.6). The refuge was incorporated in the registry because it possesses exceptional value in illustrating the natural history of the U.S. A large section of the Main Pool, including Maple Island and Black Lake, is representative of conditions in the original marsh in which broad expanses of cattail marsh were interspersed with old river channels and ponds. This area serves as a resting and feeding area for migrating waterfowl and provides nesting habitat for many species of ducks, herons, other waterbirds, neotropical migrant songbirds, and bald eagles (*Haliaeetus leucocephalus*). The Swamp Woods RNA is part of the Montezuma Marshes NNL. The New York State Thruway forms the northern border of the landmark. Habitat fragmentation resulting from the thruway and pipelines are the greatest threat to this NNL.

Plants and Animals

Birds

The bird list for Montezuma NWR includes 320 species that have been identified on the refuge since its creation in 1938. Of these, 117 species of birds are known to nest on the refuge. The New York Important Bird Area Program recognized the MWC for providing stopover and foraging habitat for one of the largest concentrations of waterfowl in the Northeast. Wading birds and shorebirds are also observed during spring and fall migration (National Audubon Society 2011). The MWC also harbors a suite of nesting bird species of conservation concern including pied-billed grebe (*Podilymbus podiceps*), least bittern (*Ixobrychus exilis*), osprey (*Pandion haliaetus*), bald eagle (*Haliaeetus leucocephalus*), black tern (*Chlidonias niger*), sedge wren (*Cistothorus platensis*), and cerulean warbler (*Dendroica cerulean*). In addition, most of the forested wetlands in this region were historically cleared or drained so the bird species that use this habitat are of conservation concern. Montezuma NWR supports this habitat type along with many breeding birds associated with these forests, including sharp-shinned hawk (*Accipiter striatus*), black-billed cuckoo (*Coccyzus erythropthalmus*), eastern wood-pewee (*Contopus virens*), wood thrush (*Hylocichla mustelina*), cerulean warbler, rose-breasted grosbeak (*Pheucticus ludovicianus*), and Baltimore oriole (*Icterus galbula*).

The MWC was part of a national program called MAPS (Monitoring Avian Productivity and Survivorship) from 1999 through 2004. The major objective of the MAPS program is to contribute to the avian population monitoring system for North American landbird species by providing data necessary to estimate population size, post-fledging productivity, adult survivorship, and recruitment into the adult population. The Montezuma MAPS station was located in early successional habitat (shrubland), and the most common species captured during the breeding seasons in 1999, 2000, and 2001 were song sparrow (*Melospiza melodia*), yellow warbler (*Dendroica petechia*), and gray catbird (*Dumetella carolinensis*).

Important Bird Area

The MWC has been identified as a globally significant Important Bird Area in New York State by the National Audubon Society (2011). The IBA program is an international bird conservation initiative to identify and conserve the most important places for birds. IBAs are identified according to standardized, scientific criteria through a collaborative effort among state, national, and international nongovernmental conservation organizations (NGOs), state and federal government agencies, local conservation groups, academics, grassroot environmentalists, and birders. IBAs are sites that provide essential habitat for one or more species of birds. They include sites for breeding, wintering, and/or migrating birds, and may be a few acres or thousands of acres, but usually they are discrete sites that stand out from the surrounding landscape. IBAs may include public or private lands, or both, and they may be protected or unprotected. The MWC IBA is noted for its diversity of habitats, hosting one of the largest migratory concentrations of waterfowl in the Northeast, as one of the most significant stopover and foraging locations for shorebirds in upstate New York, and as a site for many breeding at-risk species.

In 1997 the NYSDEC established the Bird Conservation Area (BCA) Program modeled after the IBA program. The BCA program safeguards and enhances bird populations and their habitats on State-owned lands and waters. The Northern Montezuma Wildlife Management Area is a BCA within the complex (Burger et al. 2005). This designation ensures that bird conservation concerns are a priority in management plans.

Waterfowl

The Montezuma NWR supports one of the largest migratory concentrations of waterfowl in the Northeast. On the refuge, impoundments are managed to provide optimal habitat for migrating waterfowl. During fall migration, waterfowl require large amounts of carbohydrate-rich foods to aid their migration and build up their energy reserves. The refuge periodically drains impoundments in the spring to promote the growth of moist-soil vegetation; seeds of these plants provide a readily available source of carbohydrates. In advance of fall migration, wetlands that have been drawn down are reflooded in preparation for the arrival of waterfowl.

Spring migrant waterfowl require large amounts of protein-rich foods to prepare them for the remainder of their northward migration. Invertebrate populations thrive on the residual annual vegetation resulting from the previous year's drawdown, and they emerge as soon as temperatures rise sufficiently to melt the ice. Additionally, this protein-rich diet is supplemented by carbohydrate-rich seeds produced by annual plants during previous years which are still available the following spring to northward migrating waterfowl.

High counts of the most abundant waterfowl species of conservation concern on the refuge reported by birders and volunteers for the years 1990 to 2010 are shown in table 2.6.

Table 2.6. Peak Numbers of the Most Abundant Waterfowl Species of Conservation Concern on Montezuma NWR from 1990 to 2010 (*www.ebird.org* and refuge unpublished data).

Species	Spring Migration		Fall Migration	
	Approximate Peak Date	Peak Number	Approximate Peak Date	Peak Number
Tundra swan (*Cygnus columbianus*)	Beginning of March	600	Late November	1,800
Canada goose (*Branta canadensis*)	Beginning of March	18,500	Beginning of December	31,300
Canvasback (*Aythya valisineria*)	Mid-March	12,000	November	8,000
Green-winged teal (*Anas crecca*)	Late April	2,514	Late October	7,043
Mallard (*Anas platyrhynchos*)	Beginning of March	625	Late November	3,500
Northern pintail (*Anas acuta*)	Beginning of March	2,650	Beginning of December	4,000
Redhead (*Aythya americana*)	Mid-March	5,000	Mid-October	250

Shorebirds

The Montezuma Marsh basin was historically the most significant migratory stopover site for shorebirds in upstate New York and is still considered one of the most important inland shorebird sites in the Northeast. On the refuge, water levels in some impoundments are managed seasonally to provide exposed mudflats for foraging shorebirds (see the refuge's habitat management plan for additional details; USFWS 2008b). High counts of the most abundant shorebirds on the refuge reported by birders and volunteers for the years 1990 to 2010 are shown in table 2.7.

Table 2.7. Peak Numbers of the Most Abundant Shorebird Species on the Montezuma NWR from 1990 to 2010 (*www.ebird.org*).

Species	Spring Migration		Fall Migration	
	Approximate Peak Date	Peak Number	Approximate Peak Date	Peak Number
Semipalmated plover (*Charadrius semipalmatus*)	Beginning of May	300	Beginning of August	273
Greater yellowlegs (*Tringa melanoleuca*)	Late April	105	Late September	162
Lesser yellowlegs (*T. flavipes*)	Beginning of May	200	Late July	800
Semipalmated sandpiper (*Calidris pusilla*)	Beginning of June	555	Late August	558
Least sandpiper (*C. minutilla*)	Beginning of May	1,701	Late July	1,350
Pectoral sandpiper (*C. melanotos*)	Beginning of May	55	Late August	365
Dunlin (*C. alpine*)	Late May	272	Mid-October	432
Short-billed dowitcher (*Limnodromus griseus*)	Late May	50	Late August	350

Marsh and Wading Birds

Emergent marsh impoundments on the refuge support a diversity of marsh nesting birds. Callback surveys conducted during 2009 and 2010 confirmed breeding by American bittern (*Botaurus lentiginosus*), least bittern, pied-billed grebe, Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), American coot (*Fulica americana*), and common moorhen (*Gallinula chloropus*).

Black terns produced approximately 500 young on the refuge in 1958. By the early 1990s, there were none nesting on the refuge, probably due to the purple loosestrife invasion and declining black tern populations Statewide because of habitat loss. By 1998, black terns were nesting on the refuge again in low numbers. In 2009, 22 nesting pairs were observed on Tschache Pool (USFWS 2008b).

A nesting colony of great blue herons (*Ardea herodias*) has been present on the refuge many years throughout the history of the refuge. Nest colonies move, and the rookeries have been in various locations on the refuge, including Maple Island, Tschache Pool, and Unit 17 East. Black-crowned night-herons (*Nycticorax nycticorax*) also nested on the refuge in the 1980s.

Sandhill Crane

In the U.S., by the 1930s the sandhill crane (*Grus canadensis*) population was nearly decimated across its range (USFWS 2008b). Sandhill cranes were first observed on the complex during spring migration in 1999. In 2003, a few cranes were observed during migration and the first confirmed breeding occurred. A pair with young was observed again in the 2004 through 2010 breeding seasons. Today the population has recovered to 650,000 birds and several states including New York, Pennsylvania, Ohio, and Iowa, which are part of a range expansion (USFWS 2008b).

Landbirds

One-day migration counts were conducted on the MWC in May from 1994 to 1997. The following species of concern were observed: osprey, bald eagle, northern harrier (*Circus cyaneus*), peregrine falcon (*Falco peregrinus*), sharp-shinned hawk, common nighthawk (*Chordeiles minor*), chimney swift (*Chaetura pelagica*), northern flicker (*Colaptes auratus*), horned lark (*Eremophila alpestris*), willow flycatcher (*Empidonax traillii*), wood thrush, brown thrasher (*Toxostoma rufum*), blue-winged warbler (*Vermivora cyanoptera*), cerulean warbler, prothonotary warbler (*Protonotaria citrea*), scarlet tanager (*Piranga olivacea*), rose-breasted grosbeak, field sparrow (*Spizella pusilla*), bobolink, eastern meadowlark (*Sturnella magna*), rusty blackbird (*Euphagus carolinus*), and Baltimore oriole.

Within the last 2 to 3 years, NYSDEC and the Service have been conducting winter raptor surveys. Many raptors have been identified on the refuge including two State-listed species, the short-eared owl and northern harrier. They were found to be using grasslands and marshes on the refuge and in the MWC. Recent radio telemetry records of a short-eared owl show use of the refuge's Main Pool.

The Service also conducted a breeding bird survey on the refuge in 1995. The 10 most frequently recorded species were song sparrow, American robin (*Turdus migratorius*), yellow warbler,

common yellowthroat (*Geothlypis trichas*), red-winged blackbird (*Agelaius phoeniceus*), eastern wood-pewee, brown-headed cowbird (*Molothrus ater*), swamp sparrow (*Melospiza georgiana*), veery (*Catharus fuscescens*), and wood thrush.

Breeding bird surveys were conducted in Units 17 East and West and the Main Pool Forest from 2007 to 2010. The following species of concern at the time were detected: Baltimore oriole, hooded merganser (*Lophodytes cucullatus*), northern flicker, rose-breasted grosbeak, scarlet tanager, wood duck (*Aix sponsa*), song sparrow, willow flycatcher, and wood thrush. In 2007, wood thrush was the third most abundant species found in all units combined, after American robin and eastern wood-pewee, and was present at half of the points surveyed.

Breeding bird surveys focused on grassland breeding birds were conducted in four grassland tracts from 2007 to 2010. The following grassland obligate species were detected: bobolink, grasshopper sparrow (*Ammodramus savannarum*), sedge wren, vesper sparrow (*Pooecetes gramineus*), eastern meadowlark, and savannah sparrow (*Passerculus sandwichensis*).

Breeding bird surveys focused on shrubland breeding birds were conducted in five shrubland tracts in 2009 and 2010. The following species of conservation concern were detected: northern flicker, rose-breasted grosbeak, song sparrow, willow flycatcher, savannah sparrow, black-billed cuckoo, blue-winged warbler, Baltimore oriole, cerulean warbler, wood thrush, and field sparrow.

Cerulean Warbler

The MWC is one of four sites in New York with exceptional numbers of cerulean warblers recorded during the Cerulean Warbler Atlas Project. This warbler is among the highest priority landbirds for conservation in the U.S. based on a small total population size and a significant decline in Breeding Bird Survey (BBS) trend throughout its range (minus 4.2 percent per year since 1966) (Rosenberg et al. 2000). On the Montezuma complex the cerulean warbler occurs in riparian, forested wetlands. Despite the extensive agricultural landscape, the MWC supports the second highest concentration of ceruleans in New York. The largest number of singing males (87) was found at the Howland's Island area, 77 males were found around and west of May's Point Pool, and 40 males were found in the Mud Lock area south of Routes 5 and 20. Cerulean warblers also were found on Maple Island, in the Seneca Trail area, and along the Clyde River.

Bald Eagle

Prior to the 1950s more than 70 pairs of bald eagles nested in New York State, but by the 1960s only one active nest remained. In the 1970s New York led the national recovery of the bald eagle by reintroducing young wild birds into new artificial nest sites. Between 1976 and 1980, 23 young eagles were reintroduced and fledged at Montezuma NWR. After two released birds successfully nested off the refuge in 1980, the program expanded to three more sites in New York. The first wild pair of eagles nested again on Montezuma NWR in 1987, after a 30-year absence. Two pairs nested on the refuge in 1994. Most of the eagle activity on the refuge occurs around Tschache Pool, the site of two of the three active nesting territories. However, adult and immature eagles use the refuge throughout the year. While the Main Pool was draining to encourage vegetative growth in 2007, 59 bald eagles were counted in one morning in early June.

Mammals

The most commonly observed mammal species at Montezuma NWR include eastern cottontail (*Sylvilagus floridanus*), woodchuck (*Marmota monax*), gray squirrel (*Sciurus carolinensis*), muskrat (*Ondatra zibethicus*), red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), mink (*Neovison vison*), beaver (*Castor canadensis*), and white-tailed deer (*Odocoileus virginianus*).

Recently, the New York River Otter Project has assisted in the expansion of the otter range into western New York. Over 270 otters were released in the western regions of the State between 1995 and 2000. In fall 1995, the first year of the New York River Otter Project, 21 river otters (*Lontra canadensis*) were released at 3 different locations in the northern MWC. Otters had been missing from this area for more than 100 years because of habitat loss and overharvesting. Now there are several otter territories on the refuge.

Small mammals, such as the meadow vole (*Microtus pennsylvanicus*), shrews, and moles are abundant on managed grasslands and provide important prey items for other species of concern.

The importance of flooded forests and emergent wetlands on the refuge as summer bat habitat has been recently documented through acoustic surveys in cooperation with NYSDEC. Preliminary results suggest exceptionally high concentrations of big brown bats (*Eptesicus fuscus*) along the Main Pool and tri-colored bats (*Perimyotis subflavus*) throughout the complex.

Reptiles and Amphibians

Sleggs (1997) conducted a baseline inventory of reptiles and amphibians on the refuge in 1995 and 1996 using various methods including evening audio surveys for frogs and toads, visual encounter surveys, and live-trapping using pitfalls, drift fences, funnel traps, minnow traps, and aquatic hoop traps. Frogs and toads recorded during this survey included American toad (*Bufo americanus*), gray treefrog (*Hyla versicolor*), spring peeper (*Pseudacris crucifer*), western chorus frog (*Pseudacris triseriata*), bullfrog (*Rana catesbeiana*), green frog (*R. clamitans*), wood frog (*R. sylvatica*), and northern leopard frog (*R. pipiens*). Salamanders included mudpuppy (*Necturus maculosus*), Jefferson/blue spotted salamander (*Ambystoma jeffersonianum-laterale*) hybrid, and northern two-lined salamander (*Eurycea bislineata*). Spotted salamanders (*Ambystoma maculatum*) also have been documented. Turtles observed during the survey included snapping turtle (*Chelydra serpentine*), common musk turtle (*Sternotherus oderatus*), midland (*Chrysemys picta marginata*), and eastern painted turtles (*C. p. picta*). Documented snakes include northern water snake (*Nerodia sipedon*), northern brown snake (*Storeria dekayi dekayi*), and eastern garter snake (*Thamnophis sirtalis*).

The refuge has potential habitat for a number of other reptile and amphibian species including eastern newt (*Notophthalmus viridescens*), northern dusky salamander (*Desmognathus fuscus*), Allegheny mountain dusky salamander (*D. ochrophaeus*), four-toed salamander (*Hemidactylium scutatum*), eastern red-backed salamander (*Plethodon cinereus*), pickerel frog (*Rana palustris*), spotted turtle (*Clemmys guttata*), wood turtle (*Glyptemys insculpta*), milksnake (*Lampropeltis triangulum*), brown snake (*Storeria dekayi*), eastern ribbon snake (*Thamnophis sauritus*), and smooth green snake (*Liochlorophis vernalis*) (Gibbs et al. 2007). The New York Natural Heritage Program determined that habitat for the federally listed, threatened, State-endangered bog turtle (*Glyptemys muhlenbergii*) does not exist on the refuge (Sechler 2008).

Fish

Foust (2003) conducted a baseline inventory of fish on Montezuma NWR in July 2003; most previous fisheries information for the refuge was anecdotal. Electrofishing and minnow traps were used to sample fish in portions of the Erie and Cayuga-Seneca canal systems, Seneca River, Old Seneca River, Main Pool, and numerous tributaries and ponds. The fish habitat within the refuge consists of manmade canal systems with few natural water bodies. The canals provide a relatively homogenous habitat that is typically turbid with minimal aquatic vegetation.

Foust captured 37 species, 26 genera, 15 families, and 10 orders of fish. Only one species, brown bullhead (*Ameiurus nebulosus*), was present in all sample sites. The most commonly encountered species were common carp (*Cyprinus carpio*), golden shiner (*Notemigonus crysoleucas*), bluegill (*Lepomis macrochirus*), brown bullhead, and yellow perch (*Perca flavescens*). The most abundant fish, common carp, represented 20 percent of the total catch within the refuge. The less altered areas of the Seneca River provided the most diverse fish assemblage (24 species) with bluegill being the most abundant. The most common species in the Main Pool was golden shiner followed by goldfish (*Carassius auratus auratus*). The nutrient rich pool had an organic substrate but the water was relatively clear, providing a nursery ground for golden shiners, goldfish, brown bullhead, and yellow perch. Larger carp are denied access to the Main Pool by a fish deterrent wheel at the outflow. Despite turbid conditions and few macrophytes, the Cayuga-Seneca and Erie Canals support a relatively diverse fish population (Foust 2003).

Invertebrates

Invertebrates are abundant on the refuge and play an integral role as a food source and in maintaining the ecological balance of several refuge ecosystems. The refuge has not yet conducted a systemic inventory of all invertebrate species.

Threatened and Endangered Species (Federal and State)

The federally and State-listed endangered Indiana bat (*Myotis sodalis*) has been found on Howland's Island on the NYSDEC Northern Montezuma WMA and likely occurs on the refuge. In addition to hundreds of relatively more common wildlife species, refuge habitats support breeding or critical migratory populations of several other State-listed, endangered or threatened species (i.e., lake sturgeon (*Acipenser vulvescens*), pied-billed grebe, bald eagle, black tern, short-eared owl (*Asio flammeus*), northern harrier, least bittern, peregrine falcon, sedge wren, and possibly common tern). The bald eagle is no longer federally listed, but remains State-listed and under the protection of the Bald and Golden Eagle Protection Act, the Migratory Bird Treaty Act, and the Lacey Act. State-listed species of special concern found during the breeding season on the refuge also include cerulean warbler, red-shouldered hawk (*Buteo lineatus*), sharp-shinned hawk, Cooper's hawk (*Accipiter cooperii*), horned lark, vesper sparrow, grasshopper sparrow, American bittern, osprey, and possibly blue-spotted and Jefferson salamanders, and spotted and wood turtles.

In addition to the rare bird species, the New York Natural Heritage Program reported from the refuge the blue-tipped dancer damselfly (*Argia tibialis*) as a rare invertebrate, and holly-leaved naiad (*Najas marina*) as a State-listed endangered plant (Young 2010).

Rare Plants and Significant Ecological Communities

The New York Natural Heritage Program tracks rare species and rare or exemplary ecological communities in the State. The program provided a list of rare plants and significant ecological communities known to occur on or near the refuge (see appendix A). The New York Natural Heritage Program considers three vegetation associations at Montezuma NWR to be significant occurrences of natural communities: floodplain forest, silver maple-ash swamp, and red maple-hardwood swamp (Edinger et al. 2002).

The Seneca River Montezuma Floodplain Forest extends 12 miles from the Howland's Island Unit of Northern Montezuma WMA south to the north end of Cayuga Lake. This floodplain forest is considered significant due mainly to its extensive range. Patches at Montezuma NWR occur between the Clyde River and Erie Canal, and along the Seneca River. Despite being discontinuous, this floodplain forest remains one of the largest examples of floodplain forests in the State.

The silver maple-ash swamp is a small example of what is an uncommon natural community type in New York. This occurrence includes 102 acres of the Cerulean Forest Unit. This basin swamp is dominated by silver maple and black ash with an understory dominated by northern spicebush. This swamp is significant due to being in good condition, with good species and structural diversity. Common buckthorn is present on the periphery of this swamp, and is a threat to the ecological integrity. This swamp also has the potential to contain rare plant species such as shellbark hickory (*Carya laciniosa*), a threatened S2 species of concern in New York.

The red maple-hardwood swamp is the 456-acre Main Pool Forest that contains the Swamp Wood Natural Area. This swamp is dominated by red maple, with green ash present in the canopy. The understory is dominated by northern spicebush, highbush blueberry, skunk cabbage, and false nettle. There are very few exotics in this swamp, with only common buckthorn occurring in significant abundance on the periphery (Sechler 2008).

Invasive Species

Invasive species are organisms that are introduced into a nonnative ecosystem and which cause, or are likely to cause, harm to the economy, environment, or human health. Invasive species affect native populations of animals and plants through various means, including competition, predation, altered ecosystem processes, and new disease/parasite vectors, often resulting in reduced biodiversity and requiring costly control efforts (Simberloff 2000, Pimental et al. 2004).

Invasive Plants

Table 2.8 lists invasive plant species occurring on and around Montezuma NWR.

Table 2.8. Invasive Plant Species On and Around Montezuma NWR.

Common Name	Species	Comment
Norway maple	*Acer platanoides*	
Tree of heaven	*Ailanthus altissima*	
Garlic mustard	*Alliaria petiolata*	
Burdock	*Arctium* sp.	

Common Name	Species	Comment
Japanese barberry	*Berberis thunbergii*	
Flowering rush	*Butomus umbellatus*	
Nodding plumeless thistle	*Carduus nutans*	Occurs in Yates and Tompkins Counties but not known to occur on refuge.
Carline thistle	*Carlina vulgaris*	
Oriental bittersweet	*Celastrus orbiculatus*	
Knapweed	*Centaurea sp*	
Canada thistle	*Cirsium arvense*	
Bull thistle	*Cirsium vulgare*	
European (pale) swallow-wort	*Cynanchum rossicum*	
Autumn olive	*Elaeagnus umbellata*	
Giant hogweed	*Heracleum mantegazzianum*	Occurs in Cayuga and Wayne Counties but not known to occur on refuge.
Common (European) frogbit	*Hydrocharis morsus-ranae*	
Pale yellow Iris	*Iris pseudacorus*	
Nonnative bush honeysuckles	*Lonicera* spp.	
Purple loosestrife	*Lythrum salicaria*	Effectively managed with biological control agents.
Yellow sweetclover	*Melilotus officinalis*	
Japanese stiltgrass	*Microstegium vimineum*	
Eurasian watermilfoil	*Myriophyllum spicatum*	
Princess tree	*Paulownia tomentosa*	Occurs in Tompkins County but not known to occur on refuge.
Reed canary grass	*Phalaris arundinacea*	
Nonnative common reed	*Phragmites australis*	
Japanese knotweed	*Polygonum cuspidatum*	
Curly pondweed	*Potamogeton crispus*	
Fig buttercup	*Ranunculus ficaria*	Occurs in Cayuga County but not known to occur on refuge.
Common buckthorn	*Rhamnus cathartica*	
Black locust	*Robinia pseudoacacia*	
Multiflora rose	*Rosa multiflora*	
Wine raspberry	*Rubus phoenicolasius*	Occurs in Cayuga and Wayne Counties but not known to occur on refuge.
Water chestnut	*Trapa natans*	Occurs in Seneca River on the Northern Montezuma Wildlife Management Area but not known to occur on refuge.

Invasive Animals

The most invasive animal species on the refuge is the common carp, which destroys wetland vegetation and causes high turbidity in refuge wetlands. The round goby (*Neogobius melanostomus*) has recently been documented within the MWC. This nonnative fish can displace native fish, eat their eggs and young, and take over optimal habitat. The European starling (*Sturnus vulgaris*) and the house sparrow (*Passer domesticus*) are the two most common invasive bird species found on the refuge. They compete with native species for nest sites. Other invasive wildlife species occurring on the refuge include the mute swan (*Cygnus olor*), feral and free-roaming cats, and the Norway rat (*Rattus norvegicus*). Feral pigs are in Cortland and Wayne Counties but have not been seen on the refuge. Trumpeter swans (*Cygnus buccinator*) currently breeding on the refuge are the result of releases from captive breeding programs. Their status as a native bird in New York State is unclear (McGowan 2008). However, their population is increasing rapidly in the area, as a result of several human introductions. Their impact is unknown at this time but warrants further monitoring or research. The number of resident population Canada geese is increasing in the area. Their impact on refuge habitats may need to be monitored.

Cultural and Historical Resources

To complement the CCP process, we commissioned an archaeological overview of Montezuma NWR that was completed in 2010 (GAI Consultants 2010). The following is summarized from this document.

Archaeological and Historical Resources

The archaeological record within the Montezuma NWR offers evidence of thousands of years of settlement by Native Americans, and of later occupations by European-Americans during the historical period. The variety within this record is indicated by previously documented archaeological sites, although no comprehensive testing program has been completed at the refuge. Within the approved acquisition boundary, the refuge contains nine known Native American sites, all in the southeastern portion of the refuge. These sites represent occupations that began as early as 8,000 years ago, and occurred until the period of European contact. Historical map research suggests that there may be more than 100 European-American archaeological sites within the approved acquisition boundary, which have the potential to provide insights into settlement that occurred after the eighteenth century. Human settlement in all periods was concentrated in the upland areas contiguous to the Montezuma Marsh. Human activities most profoundly affected the lands within the refuge between the mid-nineteenth century and the early twentieth century, with the construction of the Erie Canal and dredging for a later canal system. These developments lowered the level of the Montezuma Marsh and opened large new areas to farming.

Native American Archaeological Resources

The availability of natural resources influenced Native American settlement at Montezuma NWR. The combination of resources was shaped over time by patterns in the geology and ecology of the Finger Lakes region.

The first human inhabitants of the region were the Paleo-Indians, who entered the Northeast approximately 11,500 years ago. Organized in small bands, the Paleo-Indians were highly mobile people who used a specialized toolkit of fluted spear points and distinctive scrapers. The environment that they knew was cool and dry. Their landscape was vegetated in a white pine-oak forest, and was populated by temperate terrestrial animals, which included many species still seen in the region today. Some displaced boreal species may have been present as well.

The successors to the Paleo-Indians were the Native Americans of the Early Archaic period, which occurred between about 9,500 and 8,000 years ago. These people knew a climate that was increasingly warm and humid and an environment where woodlands were dominated by beech, hickory, hemlock, birch, and oak. This change in vegetation was accompanied by shifts in animal populations in the Finger Lakes region. The Native Americans modified their technologies in response, adopting new forms of corner-notched and side-notched spear points, and using spear-throwing devices to launch projectiles over greater distances than was possible by hand. As forests of deciduous trees closed in over the landscape, previously barren zones offered attractive resources, such as hazelnuts, hickory nuts, butternuts, and some tuberous plants. The innovative subsistence strategies practiced by the people of the Early Archaic led them to adjust their system of settlement, as they used longer-term occupations, and took advantage of resources that were seasonally available and found in a wider variety of locations.

During the Middle Archaic period, between 8,000 and 5,000 years ago, a climatic warming trend prevailed, marked by subepisodes that were moister or drier. Oak and hickory became the dominant tree species, and by the end of the period, mixed deciduous forests prevailed, similar in composition to those seen in the region today. Mass products, such as acorns and nuts, were both nutritious and easily stored, and became a key source of food. Native Americans of the Middle Archaic period devised a variety of contracting-stem and side-notched projectile points that were suitable for hunting and fishing, and supplemented their tool kits with grinding and milling stones, ground-stone axes, drills, and wood-working tools such as adzes and celts. Archaeological evidence for Middle Archaic settlement has been recorded at the refuge.

Between 5,000 and 3,000 years ago, Native American populations grew in size and social complexity, and the settlement system became more sedentary. There was a profusion of artifact styles, as projectile points included broad spear variants, notched broad spears, and narrow-bladed, stemmed forms. Stone bowls were fashioned from steatite. Distinct cultural groups, or traditions, emerged throughout the region during the Late Archaic, and the people of these traditions adopted contrasting settlement systems.

The greater Woodland period, which archaeologists divide into three subperiods, began approximately 3,000 years ago and continued until the era of first contact with Euro-Americans. The Early Woodland period, between about 3,000 and 2,300 years ago, saw the introduction of fired clay pottery and the Native American occupation of large villages located in the floodplains of major rivers. The use of storage pits and larger habitation structures indicates that these larger settlements supported long-term occupations. People evidently used smaller sites in upland settings for specialized and seasonal purposes, such as hunting for deer and turkey, and harvesting nuts and wild plant foods. There was considerable continuity in settlement locations between the Early Woodland period and the Middle Woodland period, which occurred between

about 2,300 and 1,200 years ago, indicating that Native American subsistence strategies and settlement systems persisted during a time of climatic stability. Several sites at the refuge were occupied during the Early and Middle Woodland periods.

The Late Woodland period, from 1,200 to 500 years ago, marked the final centuries before contact between Native Americans and European explorers. The Owasco culture flourished in south-central New York. Starting about A.D. 900, maize horticulture was adopted by Native American societies in the region. Hunting, gathering, and fishing remained important subsistence activities, which shaped the annual cycle. After A.D. 1300, the storage of surplus crops enabled the establishment of permanent hamlets and larger villages. An increase in the Native American population between A.D. 1300 and 1400 may have led to competition between neighboring groups. Nucleated settlements were frequently enclosed in palisades, indicating that territorial conflicts may have flared. Village sites were marked by deep cultural deposits and many storage pits, suggesting the accumulation of surplus crops and increased sedentism. The population of Iroquois tribes apparently grew dramatically after A.D. 1450.

Located within the eastern side of the Montezuma approved acquisition boundary, Kipp Island was one of the most important Native American settlement locations ever identified in New York State. The site contained evidence of a large village, burial mound, and an extensive burial ground, and was occupied between 500 and 5,000 years ago. During the Contact period, the Cayuga Tribe of the Iroquois Nation occupied the vicinity of the refuge, and apparently had a settlement on Kipp Island during the mid-seventeenth century.

In summary, the inventory of pre-Contact Native American settlement locations at the refuge includes nine sites, with evidence of occupation as early as 8,000 years ago. Several of the sites were reoccupied multiple times during different time periods, suggesting that they offered access to natural resources that remained important over time. These sites are not well understood archaeologically and most have never been subject to systematic subsurface testing, so their dimensions, integrity, and levels of significance are unknown. Numerous additional Native American sites likely await discovery within the approved acquisition boundary.

Historic Archaeological Resources

Jesuit missionaries were active in Iroquois territory during the middle and late seventeenth century. During the eighteenth century, however, the lands that would form Cayuga County were a backwater from the colonial perspective. Shortly before 1790, the Cayuga were formally divested of their territory, and the lands were organized into townships. Many properties were given to veterans of the Continental Army as payment for military service.

The European settlement of the counties surrounding the refuge had various effects on the landscape after 1800. The first settlement occurred in the uplands adjoining the vast expanse of the Montezuma Marsh. Upland forests were cleared to create fertile farm fields. Farmers produced potatoes and wheat, and established apple orchards. Local watercourses were dammed for small sawmills and grist mills. The leaves of the cattail plant were harvested for paper production in local mills. The Montezuma Marsh itself, however, was considered a “waste of swamp” with tracts of “stagnant waters” that remained “unredeemed.”

This changed by the mid-nineteenth century, when the exploitation and draining of the marshes began in earnest. Construction of the New York State Canal System had a lasting influence in the Seneca Basin. The Erie Canal ushered in a canal boom in the 1820s, and several lateral canals were opened. The canal network was enlarged between 1835 and the mid-twentieth century to accommodate heavier barge and boat traffic. Between 1905 and 1918, engineers decided to abandon much of the original artificial channel. Rivers that the canal had been constructed to avoid were now channelized. Moreover, engineers created a lock-and-dam system. When it opened in 1918, the complex was renamed the New York State Barge Canal. The Barge Canal construction lowered the water level in the Montezuma Marsh by an average of 2 feet, enabling the fertile marsh muck to be farmed. This new agricultural land was highly productive, but it was difficult to cultivate and was subject to flooding. Farmers tended to maintain homesteads in the adjacent uplands, and there was little residential settlement within the dredged marsh zones. Recent research referring to historical maps suggests that there may be more than 100 European-American archaeological sites within the Montezuma approved acquisition boundary, which have the potential to provide insights into European-American settlement that occurred after the eighteenth century. The existence of archaeological deposits has not been verified. Historical features related to the Erie Canal, including a canal segment and a canal viaduct, have been recorded within the refuge.

As with possible Native American resources, it is likely that a program of systematic archaeological survey that addressed the refuge as a whole would identify numerous additional sites.

European Settlement

The name “Montezuma” was first used in 1806 when Dr. Peter Clark named his hilltop home “Montezuma” after the Mexico City palace of the Aztec Emperor by the same name. Eventually the Marsh, the Village, and the refuge all acquired the name.

Europeans did not extensively settle the New York portion of the Lower Great Lakes Plain until after the American Revolution. Settlers discovered large areas of potentially productive farmland. Clearing of the presettlement forests in area uplands for farming and fuelwood occurred in the early to mid-1800s. By the end of the 19th century, less than 20 percent of the original forest remained in many of the landscapes within this region (Zipperer et al. 1990). Forest cover began to increase in the early 1900s as farms were abandoned.

Socioeconomic Environment

For the purposes of this environmental assessment, the socioeconomic area of interest (AOI) includes Cayuga, Seneca, and Wayne Counties.

Population Demographics

The refuge is at the north end of Cayuga Lake in the Finger Lakes region of New York State. Although the population of New York grew by approximately 8 percent between 1990 and 2009 (table 2.9), the counties in the area of interest had relatively slow population growth or their

population declined over a similar timeframe. Seneca County grew by approximately 1 percent between 1990 and 2009, while Wayne County increased by about 5 percent between 1990 and 2000, but then experienced a decrease of 2.6 percent from 2000 to 2009 (U.S. Census Bureau 2010). The population of Cayuga County declined by about 3 percent during that timeframe. These trends mirror those seen in much of the rural areas of the State and across the nation (Johnson 2006).

Table 2.9. Population Changes Between 1990 and 2009 in Area of Interest.

	1990	2000	2009
Cayuga County	82,313	81,963	79,526
Seneca County	33,683	33,342	34,049
Wayne County	89,123	93,765	91,291
State of New York	17,990,455	18,976,457	19,541,453
Source: US Census Bureau 2010			

Employment rates in Seneca and Wayne Counties decreased by approximately 2 percent between 2000 and 2009, while they increased slightly in Cayuga County and across the State of New York (U.S. Census Bureau 2010). The average per capita income in 2009 for Cayuga, Seneca, and Wayne Counties is $22,593, or 30 percent less than the average per capita income for the State.

According to the U.S. Census Bureau (2010), approximately 5 percent of the population in Cayuga, Seneca, and Wayne Counties is 5 years of age or younger; approximately 20 percent of the population is between the ages of 5 and 19; approximately 77 percent is age 18 years or older; and about 14 percent of the area's population is 65 years or older.

The percentage of nonwhite and/or Hispanic populations in Cayuga, Seneca, and Wayne Counties ranges from 6.5 to 8 percent, with African Americans comprising about 4 percent, Asians comprising less than 1 percent, and Hispanics comprising close to 3 percent (U.S. Census Bureau 2010). Minority populations have increased slightly since 2000, while the percentage of populations identified as White has declined by more than 1 percent (U.S. Census Bureau 2010). Regional population trends show a pattern of population decline in upstate New York. On average, the population of the Finger Lakes region has declined by about 3.9 percent between 1990 and 2000 (New York State Comptroller's Office 2004). Based on these trends, it is anticipated that minority populations will continue to grow slowly in the region.

The average household income in the area ranges from $45,571 to $52,351, with Wayne County at the higher end. Single female parents with children under 18 years of age comprise about 7 percent of households in the area. From a transportation perspective, the majority of commuters (approximately 80 percent) rely on a personal vehicle, whereas only about 1 percent use public transportation (U.S. Census Bureau 2010).

Economic Activity

In terms of economic activity, the three counties are very similar. The major industries are education, healthcare, and manufacturing, accounting for at least 20 percent of the jobs in each county. Retail trade and construction make up approximately 12 percent and 6 percent,

respectively in each county. Agriculture, forestry, mining and other related activities only make up about 3 percent of jobs in these three counties (U.S. Census Bureau 2010).

Land use in the tri-county area is dominated by agriculture. In Cayuga County, more than 1,010 farms cover over 60 percent of Cayuga County, with approximately 259,300 acres under cultivation. Livestock, dairy, and cash crops are the primary products (Cayuga County Chamber of Commerce 2010). For Seneca County, in 2003 there were 127,000 acres in farms, 61 percent of the county's total 207,944 acres. The leading products sold were: dairy products, grains and dry beans, cattle and calves, fruits and nuts, and hogs and pigs (Cornell University Cooperative Extension 2010). In 2007, Wayne County had 938 farms on 168,000 acres, or 45 percent of the county's land area. Apples are among the primary crop, with other important products including cherries and other tree fruit, onions and potatoes produced on the county's mucklands, dairy products, grain and vegetables (Wayne County Agricultural Development Board 2009).

County-specific data regarding the economics of wildlife-related recreational opportunities were not available during the preparation of this report. However, the Service has prepared several reports (the latest in 2006; USFWS and U.S. Department of Commerce 2006), which summarize the expenditures associated with various wildlife-related activities. Most participants engaged in wildlife watching (84 percent), followed by fishing (25 percent), and hunting (12 percent). (Note: the sum of these exceeds 100 percent as many participants engaged in more than one activity.) During 2006, State residents and nonresidents spent $3.5 billion on wildlife recreation in New York. The majority of that total was spent on equipment ($1.6 billion), followed by trip-related expenditures ($1.5 billion), licenses, contributions, land ownership and leasing, and other items ($491 million). Roughly one-third of all people engaged in wildlife activities in New York were nonresidents. Compared to 1996, the number of participants engaged in fishing and hunting declined, as did associated expenditures. During that same 10-year period, wildlife watching increased, but associated expenditures declined. Full reports (1996, 2001, and 2006) can be viewed online at: *http://www.census.gov/prod/www/abs/fishing.html*.

Oil and Gas Development

The U.S. has a long history of oil and gas development. In the last ten years, innovations in horizontal drilling and hydraulic fracturing have made extracting natural gas reserves from previously known shale formations (or shale plays) more economical (EIA 2011). There are at least two shale plays in New York that are thought to be major sources of natural gas: Marcellus Shale and Utica Shale (EIA 2012). Marcellus Shale stretches from West Virginia to southern New York State (USGS Marcellus Shale Assessment Team 2011), ending south of the refuge. Of more concern to Montezuma NWR is the Utica Shale formation. This formation is larger and deeper than the Marcellus Shale formation. It stretches from northeast Kentucky to central New York State (including the refuge), and west to include most of Ohio (Ryder 2008).

Oil and gas reserves are currently extracted from shale using horizontal drilling and hydraulic fracturing (also called fracking) (see EIA 2012 for a more thorough discussion of how oil and gas are produced from shale). Environmental effects of these methods are not well documented at this time; however, there are concerns about potential effects particularly related to water resources. USGS (2009) has identified three major concerns related to hydraulic fracturing: 1) it requires substantial amounts of water for well construction, 2) movement of heavy equipment

during well construction in rural areas can degrade small watersheds, and 3) large quantities of potentially contaminated water and fluids recovered from wells need to be disposed of safely. In addition, there is some concern that injection of wastewater from hydraulic fracturing into deep wells (one method of disposal) can cause earthquakes large enough to be felt and cause damage (USGS 2009). As with more conventional oil and gas operations, there are also concerns about potential negative effects from gas well blowouts, infrastructure development, and water and soil contamination from transport, storage, and disposal of chemicals and waste (Zoback et al. 2010).

The Federal Bureau of Land Management administers an active oil and gas project which involves a Farmers Home Administration property currently managed by the refuge. The drill site is located outside of the property, but subsurface resources underneath the property are within the project's affected area (see chapter 3, Monitoring Oil and Gas Development for additional information).

In New York State, installation of new natural gas wells has slowed dramatically while NYSDEC prepares a general environmental impact statement to address statewide effects of drilling for natural gas in Marcellus Shale (NYSDEC 2012). NYSDEC is expected to release the final environmental impact statement and associated regulations soon.

Employment and Per Capita Personal Income

Levels of employment and personal income provide important indications of the economic condition of an area. In terms of employment levels, Cayuga and Wayne Counties were very similar in 2008 (table 2.10). The number of jobs in Seneca County was roughly half of those estimated in Cayuga County and Wayne County, respectively. Total employment in the AOI was slightly less than 1 percent of those estimated in the State during 2008. Between 2000 and 2008, employment levels shifted most dramatically in Seneca County (a 27 percent decline) and Wayne County (a 56 percent increase). Overall, the AOI exhibited a 12 percent increase in the number of jobs since 2008, which was similar to what was seen across the State. It should be noted that these data represent information that was collected during the early stages of the economic recession, and current data are likely to show lower employment rates than those depicted for 2008 in table 2.10. Median personal incomes were relatively similar for each of the three counties in the AOI. The difference between the counties is how per capita income levels changed since 2000. Personal incomes increased 41 percent in Cayuga County, and a dramatic 114 percent in Seneca County. Personal incomes declined in Wayne County by 12 percent during the 8-year timeframe. Overall, personal incomes in the AOI increased, albeit less than the State (27 percent versus 41 percent), as seen in table 2.10.

Table 2.10. Employment and Personal Income Statistics for Cayuga, Seneca, and Wayne Counties, New York in 2008.

Region	Employment		Median Personal Income	
	Jobs	Percent Change Since 2000	$	Percent Change Since 2000
Cayuga County	37,733	+8	31,820	+41
Seneca County	16,790	-27	31,286	+114
Wayne County	38,548	+56	34,353	-12
Area Total	93,071	+12		
New York State	11,289,001	+9	48,809	+41

Source: U.S. Department of Commerce 2010

Refuge Administration

Staffing

Presently, staffing on the refuge consists of eight permanent, full-time positions: a refuge manager, deputy refuge manager, park ranger (visitor services manager), park ranger (visitor services), wildlife biologist, administrative officer, tractor operator, and maintenance worker (refer to appendix C). In addition, up to three temporary positions (biological technicians and park rangers) may be filled on a seasonal basis.

Funding

The funding for the refuge is allocated via the Service's Northeast Regional Office located in Hadley, Massachusetts. Operational funding includes salaries, supplies, utilities, fuel, surveys, management activities and all other operational activities that are not funded by special projects. Base maintenance funds that are used to repair vehicles, equipment, and facilities generally have been stable over the past 5 years. The replacement of vehicles, larger pieces of equipment (e.g., tractor, backhoe), or larger facilities (buildings) are funded as projects. Annual funding fluctuates

according to the number and size of special projects funded that year (e.g., vehicle or equipment replacement, visitor service enhancements, and facility improvements).

Facilities and Infrastructure

Facilities include the refuge headquarters, visitor contact station, maintenance shop, vehicle barn, equipment shed, public restrooms, and several other support buildings. The refuge maintains 3.5 miles of paved roads, and approximately 30 miles of unpaved roads. In addition, several miles of berms and numerous water control structures are maintained. Public use facilities include the visitor contact station, as well as two viewing towers, three viewing platforms, three pulloffs (overlooks), and approximately 5.5 miles of trails.

Volunteers

Volunteers, through their contributions of time, skills, and efforts, are an integral component of the success of the refuge. Volunteers staff the visitor contact station, store, and information booths at festivals. In addition, they serve as roving naturalists and participate in Montezuma Alliance for the Restoration of Species and Habitats (MARSH!) work days (invasive plant control and native plant establishment). Other tasks performed include gardening, wildlife surveys, duck banding, maintenance, and data entry. For volunteers that spend several days or weeks working on refuge projects (such as college interns), there are two camper pads with hookups and a bunkhouse. Volunteer efforts have increased significantly during the last few years, from 3,609 hours logged in 2008 to 8,323 hours in 2010.

Distributing Refuge Revenue Sharing Payments

Since 1935, the Service has made refuge revenue sharing payments to counties or towns containing lands under its administration. The actual amount of the payments is determined by formulas specified in the Revenue Sharing Act (16 U.S.C. 715s) and annual funding appropriated by Congress. The formulas used to determine payments to local municipalities are based on the number of acres in each municipality and the appraised value of refuge lands in their jurisdiction. Currently for Montezuma NWR, we make revenue sharing payments to Cayuga County, and the towns of Seneca Falls, Tyre, Clyde, Galen, and Savannah. Between fiscal years 2005 and 2009, combined payments to all municipalities have averaged about $14,500 per year.

Refuge Public Use

Special Use Permits, Including Research

Special use permits (SUPs) are issued to individuals, organizations, and agencies that request the use of refuge facilities or resources beyond what is available to the public. In order to ensure that wildlife disturbance is minimized, special conditions and restrictions are identified for each request. Since 2002, the refuge has issued an average of 13 permits per year, with specified periods ranging from 1 day to 1 year, depending on the nature of the request. Each request is individually reviewed.

The refuge supports research activities when they are compatible with the refuge purposes, and help gain knowledge and understanding to benefit management goals and objectives. Refuge

staff, graduate students, conservation organizations, and others have conducted numerous research projects on the refuge.

Land Protection and Conservation

The refuge is actively engaged in land protection efforts, having acquired over 1,100 acres since 1999 (see table 1.1 in chapter 1). Lands being targeted are in the MWC, as they become available from willing sellers. In addition to obtaining lands in fee title, the refuge has purchased several conservation easements. This land protection strategy is an alternative way of protecting wildlife habitat without purchasing the land outright. A conservation easement allows the refuge to protect wildlife habitat on a property that remains in private ownership. The refuge, for example, may purchase rights from the property owner that restrict certain uses. However, other activities, such as farming, forestry, hunting and fishing, could continue when they are consistent with conservation goals.

Partnerships

Throughout most of its history, the refuge has combined its resources with others to form a wide array of outstanding partnerships to advance common conservation objectives, including land acquisition, control of exotics, threatened and endangered species recovery, research, interpretation and education, and enhanced wildlife observation and photography opportunities. These partners include New York State Department of Environmental Conservation, Audubon New York and the Montezuma Audubon Center, Ducks Unlimited, The Nature Conservancy, The Friends of the Montezuma Wetlands Complex (Friends), Cayuga Lake Scenic Byway, Montezuma Winery, USDA agencies, US DOI agencies, NYS Canal Corporation, NYS Thruway Authority, New York State Department of Transportation (NYSDOT), local and county government offices within Seneca, Wayne and Cayuga Counties, regional sportsmen's clubs and bird clubs, local school districts, private landowners and individual volunteers. The refuge has worked very closely with a broad array of regional universities to host student and faculty research projects on the refuge and establish various partnerships. The colleges and universities that the refuge has worked with the most include: Cornell University, SUNY Environmental Science and Forestry, Finger Lakes Community College, Rochester Institute of Technology, and Hobart and William Smith College.

Visitor Services

The purpose of the visitor services program is to provide opportunities for appropriate and compatible wildlife-dependent recreation to enable the public to enjoy the refuge. Between 2006 and 2010, the refuge has averaged 143,000 annual visits per year. Visitors to the refuge can observe and photograph wildlife, fish, hunt, and participate in environmental education and interpretation. See map 3.2 for major public use facilities, such as observation towers, trails, etc. Table 2.11 illustrates the number of visits for the six major public uses that are provided on the refuge. In 2006 the Service's Northeast Region identified areas of emphasis for all of its refuges (USFWS 2006a). Wildlife observation, photography, and environmental interpretation were identified as areas of emphasis for the Montezuma NWR. For additional information on how the Service administers public uses on the refuge, please see appendix B, Findings of Appropriateness and Compatibility Determinations.

Table 2.11. Visits[1] to Montezuma National Wildlife Refuge Between 2006 and 2010.

Type of Visit[2]	2006	2007	2008	2009	2010
Visitor Contact Station	11,696	15,525	14,846	15,234	16,938
Waterfowl Hunt	600	563	352	152	355
Big Game Hunt	1,351	1,371	1,909	1,893	1,897
Fishing	4,072	4,224	3,972	3,922	3,937
Wildlife Observation and Photography	112,720	116,600	117,021	127,790	123,404
Environmental Education	524	1,986	854	949	818
Interpretive Program	480	612	922	1,450	702
Special Events	-	480	493	715	1,040
Total	131,443	141,361	140,369	152,105	149,091

[1] A refuge visit is defined as, "the entry of one person onto a Refuge System station to engage in one recreational or educational activity. …One visitor could account for several visits" (USFWS 2005a).

[2] Visitor numbers are based on direct counts by refuge staff, volunteers, a traffic counter, and a counter at the visitor contact station. Some estimation and professional judgment is used to determine visits for wildlife observation and photography, interpretation, and fishing using methods in chapter 2 of the National Wildlife Refuge System Visitation Estimation Workbook (USFWS 2005a).

Wildlife Observation and Photography Opportunities

The refuge offers numerous opportunities for wildlife observation and photography, including a 3-mile long Wildlife Drive, a photography blind, nearly 4 miles of walking trails, a floating boat dock, and several observation areas (see map 3.2). Visitors have the opportunity to view and photograph a variety of habitats and wildlife. In addition, there is currently an annual photography contest coordinated by the Friends.

Hunting

Hunting at Montezuma NWR is guided by a Hunting Plan written in 2005 and by an Annual Hunt Program document. Refuge hunting is limited to white-tailed deer and waterfowl hunting and generally follows regulations set by the New York State Department of Environmental Conservation. Detailed hunting rules and regulations are included in the Code of Federal Regulations (50 CFR) and in handouts prepared by refuge staff on an annual basis. White-tailed deer hunting occurs on 95 percent of refuge upland and forest habitats and is conducted through the issuance of self-serve refuge permits. The refuge waterfowl hunt is managed through a reservation system and is partially administered by the Friends. The refuge determines the seasons, locations, and regulations of the hunt and the Friends are responsible for administering the hunt and collecting the waterfowl hunt fee.

Fishing

Access to fishing spots from refuge lands is limited. Fishing follows New York State seasons and regulations. The refuge has one universally accessible fishing pier at May's Point, along the Seneca River (also known as the Cayuga-Seneca Canal), with parking for about 10 cars. Additionally, the refuge provides access to the NYSDEC-owned Seneca River fishing site on Route 20, across from the refuge headquarters entrance. Fishing opportunities are not provided in impoundments on the refuge. The refuge does not have jurisdiction over canal waters, but can provide access to the canals for the purpose of fishing.

Environmental Education and Interpretation

Environmental education is currently not an area of emphasis for Montezuma NWR, and with limited staff the focus is on providing opportunities for wildlife observation, photography and environmental interpretation. Staff and volunteers accommodate groups requesting programs when time permits. The refuge partners with the MAC which has a focus on environmental education. Refuge staff work with MAC environmental educators to create programs for visitors and school groups throughout the MWC.

Environmental interpretation is an area of emphasis on the refuge, second to wildlife observation. Interpretive panels and the complexwide "Guide by Cell" cellphone tour (funded by the Friends), along with the refuge's Wildlife Watching Guide, convey not only orientation information, but also refuge messages about its history and management. Special guest speaker programs are offered every other month as part of the Nature of Montezuma Series, in cooperation with the MAC, and supported by the Friends. Guided interpretive bus tours are given by refuge staff upon request and as part of the Wildflowers and Wine Festival in June and the National Wildlife Refuge Week Celebration in October. Winter program series, such as the Montezuma Book Club and Eco-Chat, have also been used as platforms for environmental interpretation.